

TOYOTA

18R ENGINE

REPAIR MANUAL

INCLUDES

18R, 18R-C & 18R-G

 **TOYOTA MOTOR SALES CO., LTD.**

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FOREWORD

This manual describes the repair procedures for the 18R, 18R-C & 18R-G engines equipped on the TOYOTA CELICA, CORONA, CRESSIDA, HI-LUX, and HI-ACE.

Under DISASSEMBLY and ASSEMBLY, you will find disassembled views which carry numbers indicating the sequence of operation procedure. The operations can be accomplished by following these numbers. To facilitate understanding, there are also some figure numbers after operation numbers showing the locations of work details. The texts have different symbol marks which supersede the figure explanation.

This manual provides complete information on the maintenance and service of those engines, and it is hoped that it will see much use.

All information contained in this manual is the most up-to-date at the time of publication, and we reserve the right to make any changes without further notice.

For service of emission control devices, refer to each emission control repair manual.

For new service specification data, refer to service specification manuals.

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GENERAL

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GENERAL REPAIR INSTRUCTION

1. Use fender, seat, and floor covers to keep the car clean and prevent damage.
2. During disassembly, keep parts in order for reassembly.
3. Before performing electrical work, disconnect the cable to the positive (+) battery terminal.
4. Always replace gaskets and O-rings with new ones.
5. Always use sealer on gaskets to prevent leaks.
6. Carefully observe all specifications for bolt torques. Always use a torque wrench.
7. Use genuine Toyota parts.
8. If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels in order to ensure safety.
9. After the vehicle is jacked up, do not fail to support it on stands. It is extremely dangerous to do any work on the vehicle raised on jack alone, even for a small job that can be finished quickly.
10. Use of a special service tool (SST) may be required, depending on the nature of the repair. Be sure to use SST where specified and follow the proper work procedure. A list of the SST is found at the back of this manual.

ABBREVIATIONS USED IN THIS MANUAL

For convenience, the following codes are used in this manual.

Abbreviation	Term	Definition
SST	Special Service Tool	This term designates tools that have been manufactured specially for the servicing of this vehicle. Their part numbers are shown in the text enclosed by [].
STD	Standard	This term refers to the dimension of the part when originally manufactured.
O/S	Oversize	Sizes larger than STD are indicated as O/S.
U/S	Undersize	Sizes smaller than STD are indicated as U/S.
MP	Multipurpose	Use in the case of MP grease.
BTDC	Before Top Dead Center	
T/M	Transmission	
TVSV	Thermostatic Vacuum Switching Valve	
AAP	Auxiliary Acceleration Pump	

SYMBOL MARK

The following symbols have been adapted for simplicity and for easy comprehension.



ASSEMBLE



DISASSEMBLE



INSTALL



REMOVE



INSPECT



MEASURE



TIGHTEN



CLEAN



IMPORTANT

18R ENGINE TUNE-UP

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18R ENGINE TUNE-UP ITEM

ITEM		REMARK
1	ENGINE OIL	
	Oil level check	"Full" line
	Oil replenishment	API service SE classification
	Oil capacity	
	RT Total	5.0 liter 5.3 US qt. 4.4 Imp.qt.
	Crankcase	3.8 liter 4.0 US qt. 3.3 Imp.qt.
	RA Total	4.7 liter 5.0 US qt. 4.1 Imp.qt.
	Crankcase	3.8 liter 4.0 US qt. 3.3 Imp.qt.
	RX Total	5.0 liter 5.3 US qt. 4.4 Imp.qt.
	Crankcase	3.9 liter 4.1 US qt. 3.4 Imp.qt.
	RN Total	5.0 liter 5.3 US qt. 4.4 Imp.qt.
	Crankcase	4.1 liter 4.3 US qt. 3.6 Imp.qt.
	Quality check	
	Oil filter replacement	SST [09228-44010]
2	COOLING SYSTEM	
	Coolant level check	"Full" line
	Quality check	
3	DRIVE BELT	
	Coolant capacity (w/heater)	8.0 liter 8.5 US qt. 7.0 Imp.qt.
	Tension Fan — Alternator	8 — 12 mm 0.35 — 0.47 in
4	AIR CLEANER	
	A/C Compressor —	
	Crankshaft	15 — 18 mm 0.59 — 0.71 in
5	BATTERY	
	Element cleaning	
	Specific gravity	1.25 — 1.27 at 20°C (68°F)
	Electrolyte level	
6	SPARK PLUG	
	Visual check	
	Cleaning	
7	HIGH TENSION CORD	
	Plug gap	0.8 mm 0.03 in
	Resistance	Less than 25 k Ω per cord
8	DISTRIBUTOR	
	Distributor cap	
	Point gap	0.45 mm
	Damping spring gap	0.1 — 0.4 mm 0.004 — 0.168 in
	Dwell angle	50 — 54°
	Dwell angle variation	within 3°
	Ignition timing	7° BTDC/750 \pm 50 rpm
	Governor operational	
	Vacuum operational	

ITEM		REMARKS
	WARM UP ENGINE	
9	VALVE CLEARANCE (HOT)	Intake 0.20 mm 0.008 in Exhaust 0.36 mm 0.014 in
10	CARBURETOR	Automatic check Check throttle valve full open Check the accelerating pump Float level
11	INITIAL IDLE SPEED	Idle speed 750 ± 50 rpm Manifold vacuum 420 mm Hg 16.5 in Hg
12	CO CONCENTRATION	1-3 %
13	ENGINE CONDITION	
14	FAST IDLE	2600 ± 200 rpm
15	COMPRESSION PRESSURE	Standard 12.0 kg/cm ² 170.4 psi Limit 9.0 kg/cm ² 127.8 psi Difference of pressure between cylinders Less than 1.0 kg/cm ² 14.2 psi

Fig. 2-1

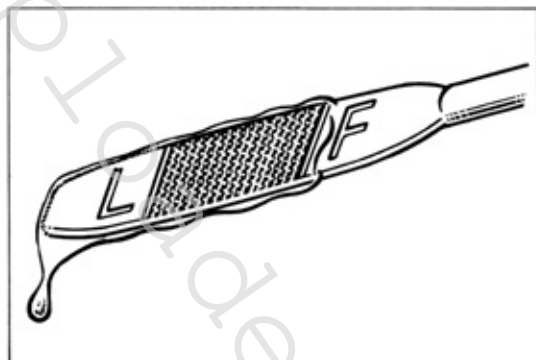


Fig. 2-2

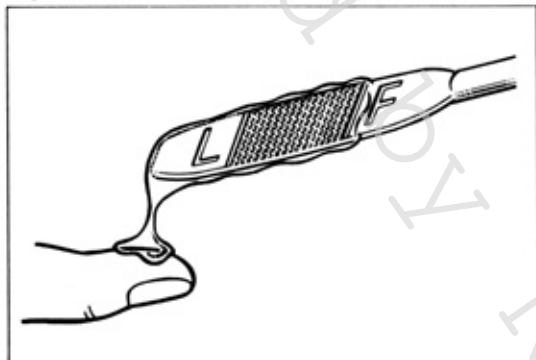


Fig. 2-3



Fig. 2-4



ENGINE OIL

LEVEL CHECK and REPLENISHMENT

Oil level should be up to the F line on the level gauge. If low, add oil up to the F line. Use API service SE classification engine oil.



QUALITY CHECK

Pull out the oil level gauge and examine the oil adhering on the graduated part. The oil should not be discolored or thin.



OIL FILTER REPLACEMENT

1. Remove the oil filter by using SST [09228-44010].
2. For installation, tighten firmly the oil filter by hand.



3. After starting the engine, check for oil leak and recheck the oil level.



Fig. 2-5



Fig. 2-6



Fig. 2-7

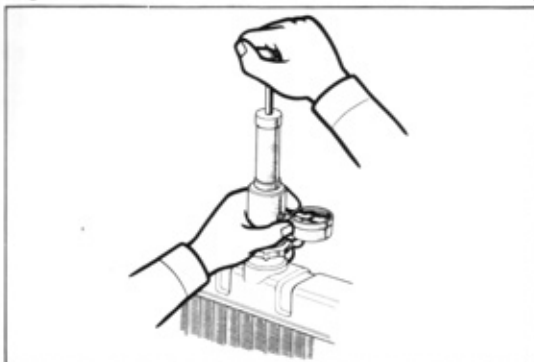
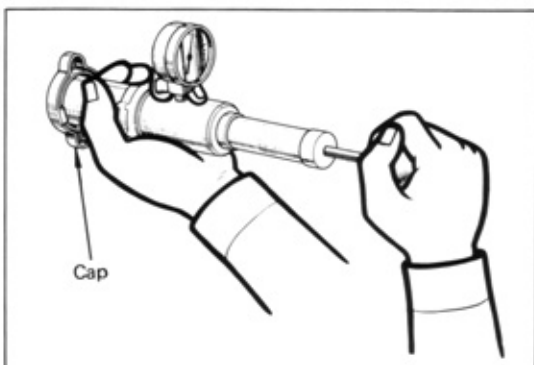


Fig. 2-8



COOLING SYSTEM

COOLANT LEVEL CHECK and REPLENISHMENT



If coolant is low, fill reservoir tank up to "Full" line.

COOLANT QUALITY CHECK



There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the coolant should also be free from oil. Replace the coolant if excessively dirty.

INSPECTION of COOLING SYSTEM PARTS



There should be no defects such as listed below:

1. Damage, deterioration, or loose clamps in radiator hoses, water hoses.
2. Leakage due to corrosion or damage in radiator core.
3. Leakage due to loose water drain cock.
4. Leakage from water pump.



5. Faulty operation of radiator cap.

Inspect the radiator cap pressure regulating and vacuum valves for spring tension and seating condition. If the valve opens at a pressure level below the specified value or is otherwise defective, replace the radiator cap.

Valve opening pressure limit

0.6 kg/cm² (8.5 psi)

Standard

0.9 kg/cm² (12.8 psi)

Fig. 2-9

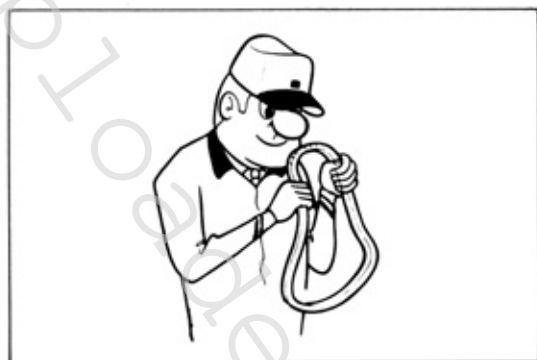


Fig. 2-10

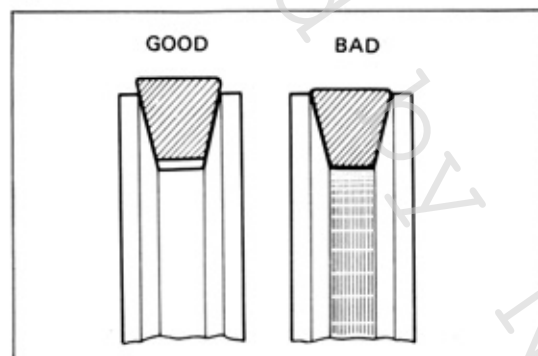


Fig. 2-11

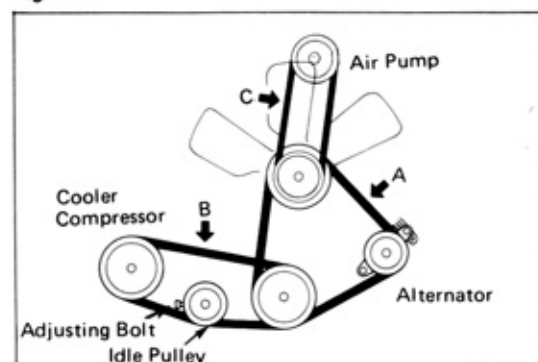


Fig. 2-12



DRIVE BELT VISUAL CHECK



There should be no defects such as listed below:

1. Cracked, deteriorated, stretched, or worn belt.
2. Adherence of oil or grease.



3. Improper contacting of belt against the pulley.

TENSION CHECK and ADJUSTMENT



When the belt is pressed down with 10 kg (22 lb) force, the belt should deflect the specified amount.

A : 9 – 13 mm (0.35 – 0.51 in)

B : 15 – 18 mm (0.59 – 0.71 in)

C : 13 – 18 mm (0.51 – 0.71 in)

— Caution —

Do not pry aluminum body of air pump.

AIR CLEANER ELEMENT CLEANING



1. In removing the air cleaner or element, and after removal, use care not to drop dirt and dust down into the carburetor.
2. In cleaning the element, blow air from the inner side.
3. In case the element is torn or excessively dirty, replace with new one.

Fig. 2-13

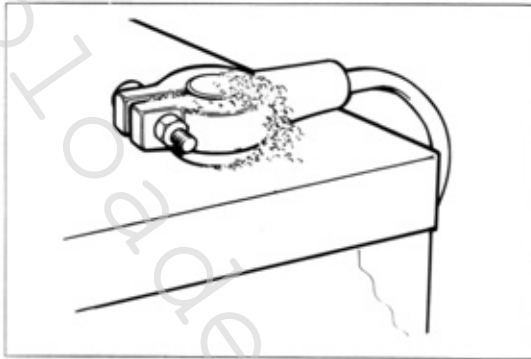


Fig. 2-14

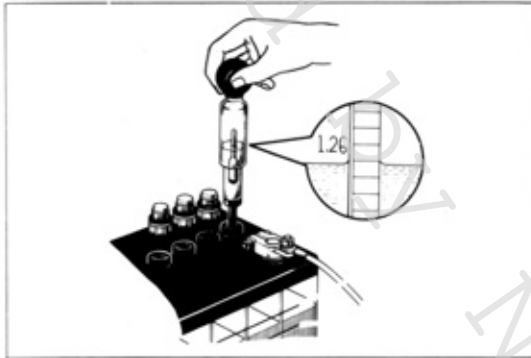


Fig. 2-15

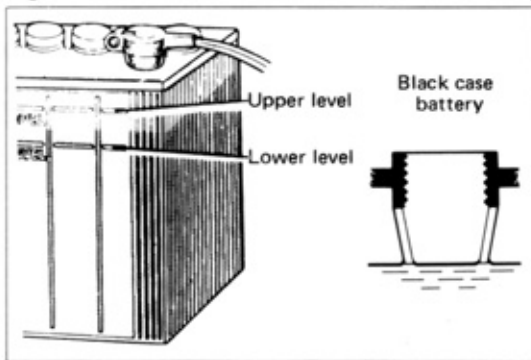
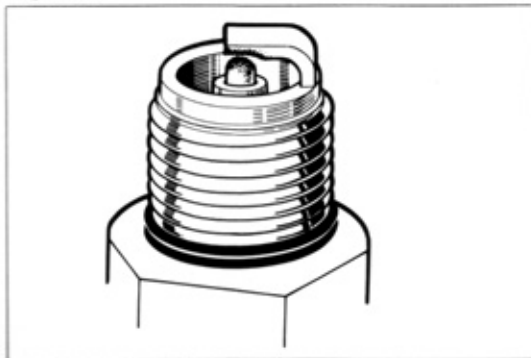


Fig. 2-16



BATTERY VISUAL CHECK



If very dirty, remove and clean before checking. There should be no defects such as listed below:

1. Rusted battery mounting hardware.
2. Damage or leakage in battery.
3. Loose connection, rusting, deterioration or corrosion of battery terminals.

SPECIFIC GRAVITY MEASUREMENT



Hold the hydrometer so that the float will not contact against the cylinder wall and read the graduation.

Specific gravity

1.25–1.27
at 20°C (68°F)

ELECTROLYTE LEVEL CHECK and REPLENISHMENT



The electrolyte level should be up to the upper level. If low, add distilled water (or purified water).

SPARK PLUG VISUAL CHECK



Condition is good if none of the following defects are present:

1. Cracks or damages in the threads or insulator.
2. Wear on the electrodes.
3. Damaged or deteriorated gaskets.
4. Burnt condition of electrode and undesirable carbon deposit.

Fig. 2-17

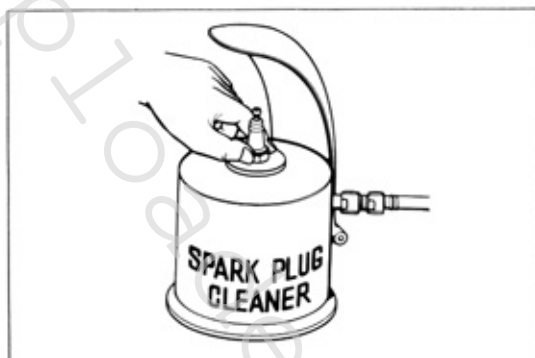


Fig. 2-18

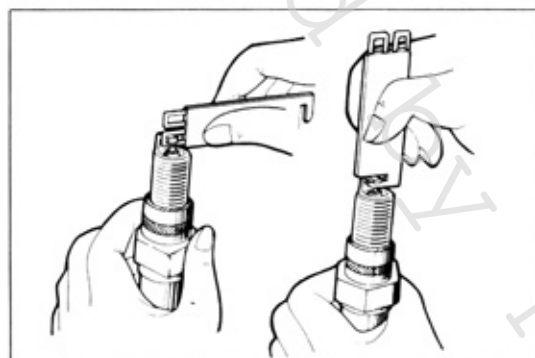


Fig. 2-19

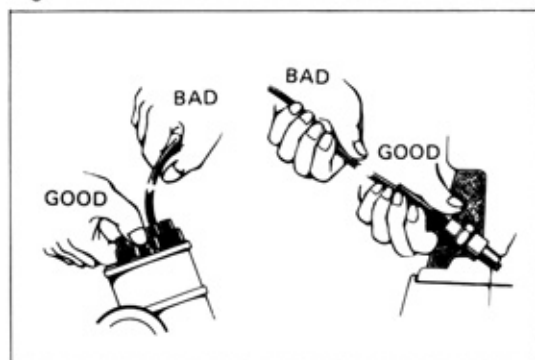
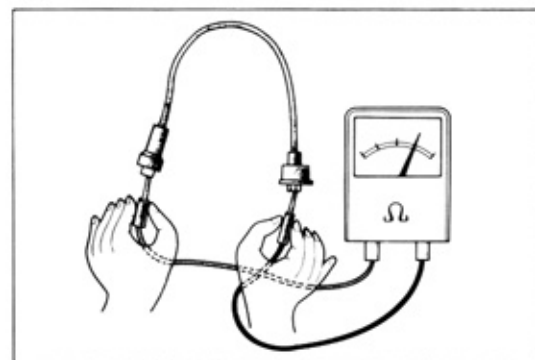


Fig. 2-20



CLEANING



1. Do not use spark plug cleaner longer than necessary.
2. Blow off cleaning compound and carbon on the threads thoroughly with air.
3. Clean off dirt from the outer surface of insulator and threads.

GAP ADJUSTMENT



Check the plug gap with plug gap gauge. If not to specified value, adjust by bending the ground (outer) electrode.

Plug gap 0.8 mm (0.031 in)

HIGH TENSION CORD



— Note —

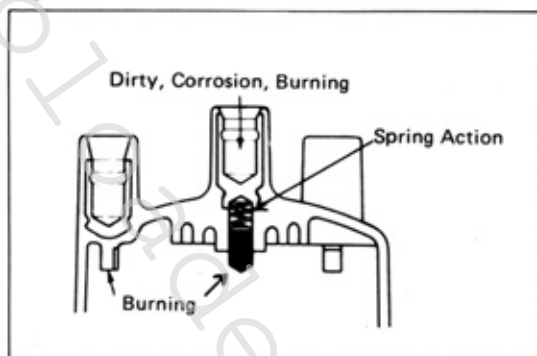
When pulling out the spark plug cord from the plug, always grip the end of plug cord.



Check the resistance of resistivity cord.

Resistance Less than 25 kΩ per cord.

Fig. 2-21

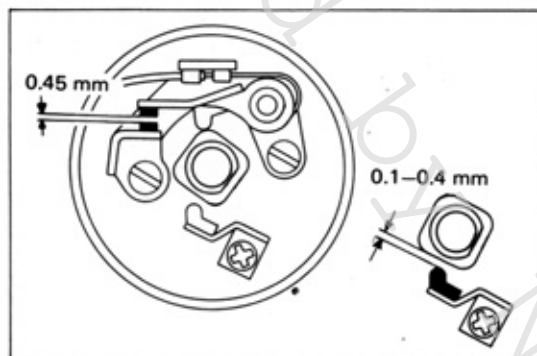


DISTRIBUTOR CAP INSPECTION

Clean the distributor cap and inspect the cap and rotor for:

1. Cracks, damage, dirty cord hole, corrosion, burning.
2. Center piece spring action.
3. Burnt electrode terminal.

Fig. 2-22



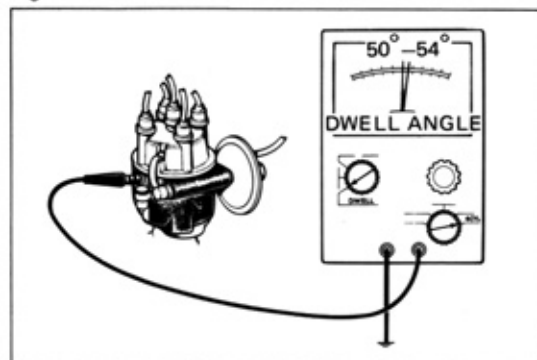
POINT GAP ADJUSTMENT

1. If the points are excessively burnt or pitted, replace the breaker points.
2. Adjust point gap and damping spring.

Point gap 0.45 mm (0.018 in)

Damping spring gap
0.1 - 0.4 mm
(0.004 - 0.168 in)

Fig. 2-23



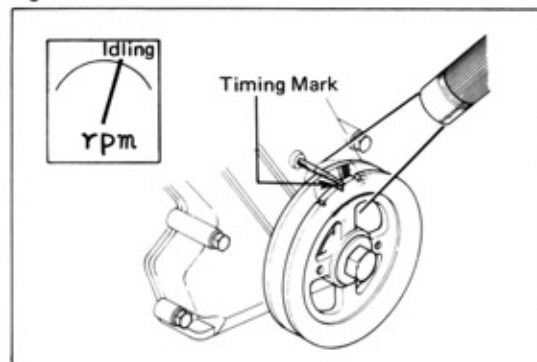
DWELL ANGLE

Check if dwell angle is within the specified value.

Dwell angle 50 - 54°

Variation
within 3° (at idling to 2000 rpm)

Fig. 2-24



IGNITION TIMING INSPECTION

Set the engine revolution at idle speed.

The octane selector must be set at standard position.

Ignition timing
7° BTDC/750 ± 50 rpm
(Red mark)

Fig. 2-25

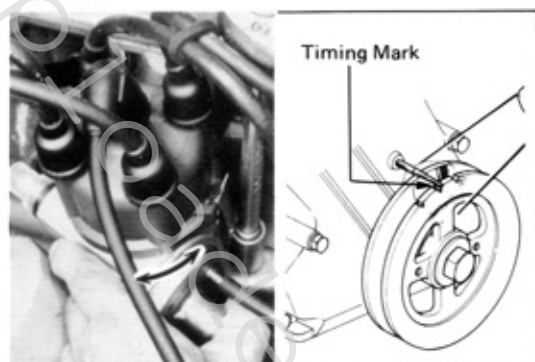


Fig. 2-26

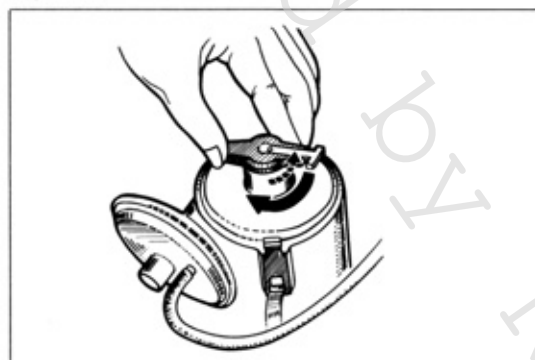


Fig. 2-27

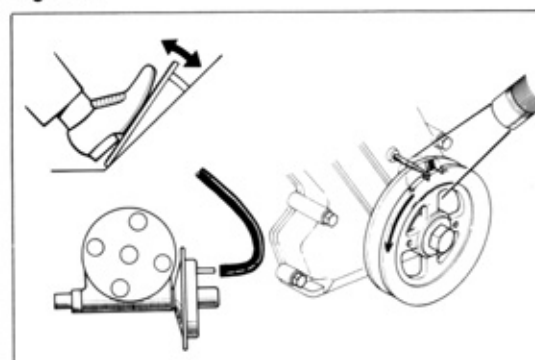
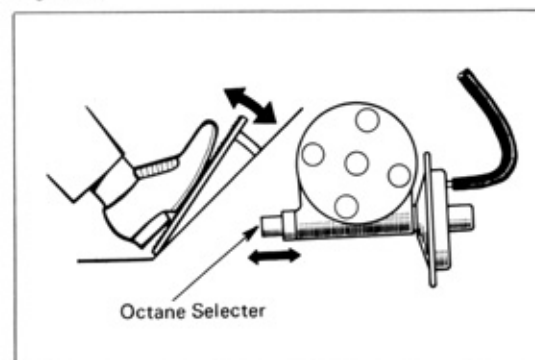


Fig. 2-28



ADJUSTMENT

Align the timing marks by turning distributor body.

Ignition timing 7° BTDC/750 ± 50 rpm
(Red mark)

GOVERNOR OPERATIONAL INSPECTION



1. Rotor should return quickly when turned clockwise by hand and released.
2. Rotor should not be excessively loose.



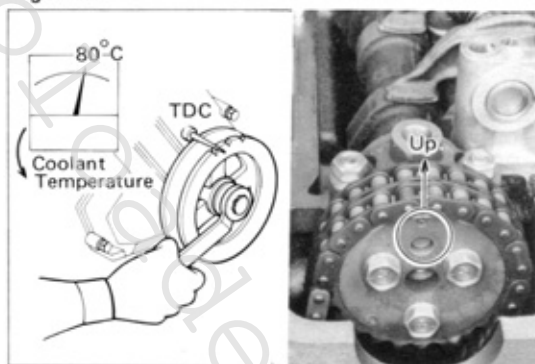
3. Start the engine and disconnect the vacuum hose from the distributor. The timing mark should vary in accordance with the opening and closing of throttle valve.

VACUUM ADVANCE OPERATIONAL INSPECTION



Connect the distributor vacuum hose. The octane selector should vary in accordance with the opening and closing of throttle valve.

Fig. 2-29

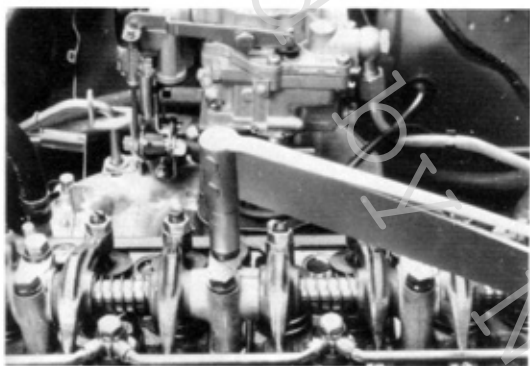


VALEVE CLEARANCE ADJUSTMENT



1. Warm up engine, then stop.
2. Set No.1 cylinder to TDC/compression. At TDC compression position, camshaft knock pin should point up.

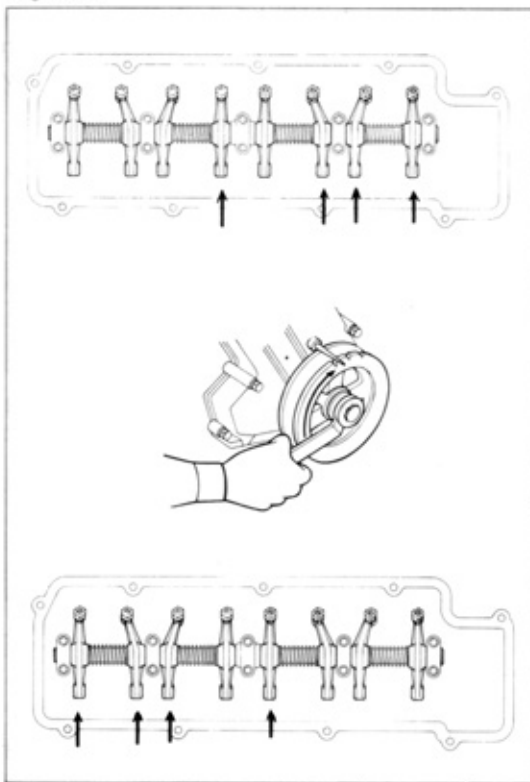
Fig. 2-30



3. Stop the engine.
4. Tighten the rocker support.

Torque **1.7 – 2.3 kg-m**
 (12.3 – 16.6 ft-lb)

Fig. 2-31



5. Make adjustment. Valve clearance is measured between valve stem and rocker arm. Adjust valves indicated by arrows only.

Intake **0.20 mm (0.008 in)**
 0.36 mm (0.012 in)



6. Rotate crankshaft 360°.
7. Adjust remaining valve as arrows.

Fig. 2-32

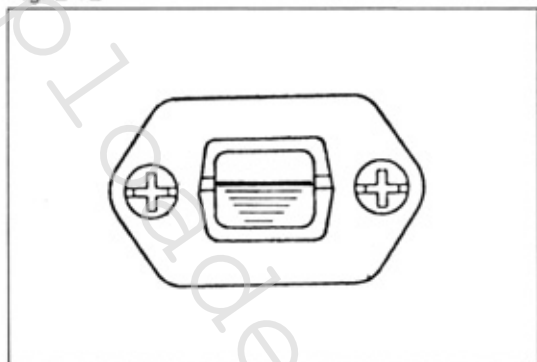


Fig. 2-33

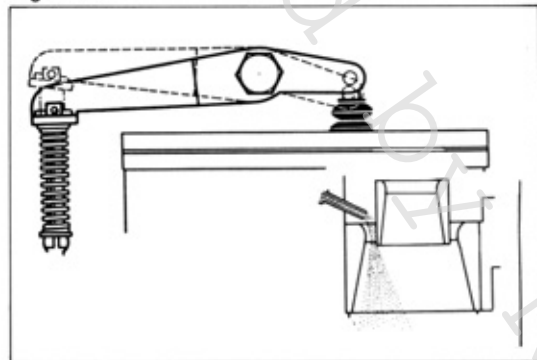


Fig. 2-34

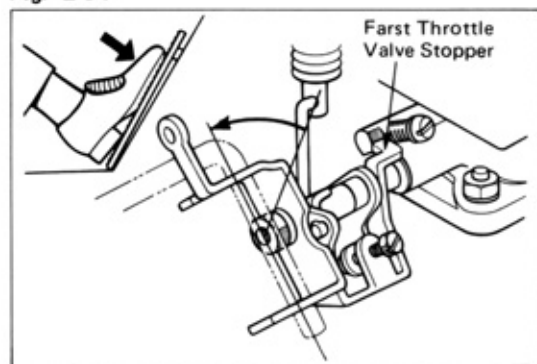
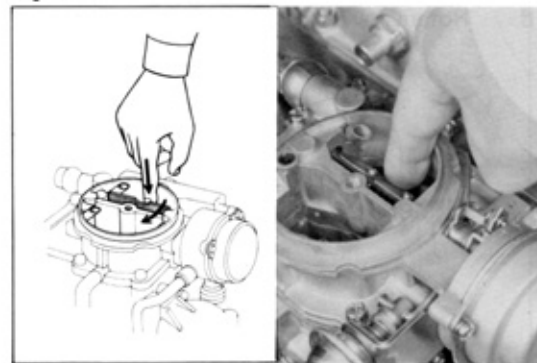


Fig. 2-35



CARBURETOR OPERATIONAL CHECK



1. Check float level.
Float level is satisfactory if the fuel level is up to the standard line when the engine is idling. For adjustment, refer to carburetor section.



2. Check the accelerating pump operation.
Gasoline should shoot out with good force from the jet when the throttle valve is opened.



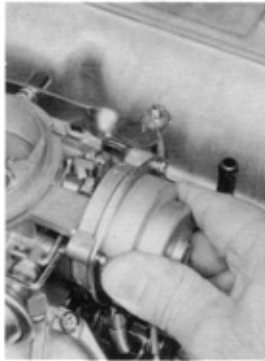
3. Check throttle valve full open.
The throttle valve should open fully when the accelerator pedal is stepped all the way down.

[COLD CONDITION] AUTOMATIC CHOKE



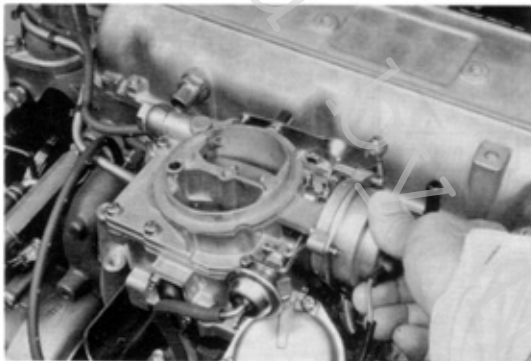
1. Check choke valve action.

Fig. 2-36



2. Choke valve becomes fully closed when atmospheric temperature reaches 25°C (77°F).

Fig. 2-37

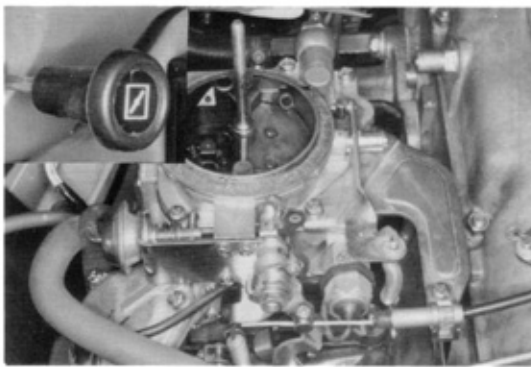


3. Depending on the vehicle operating conditions, turn the coil housing and adjust the engine starting mixture.

If too rich Turn clock-wise.

If too lean ... Turn counterclock-wise.

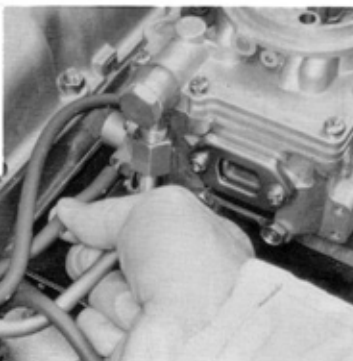
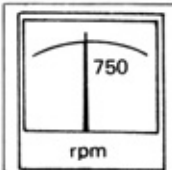
Fig. 2-38



MANUAL CHOKE

1. Choke valve becomes fully closed when fully pulled out choke knob.

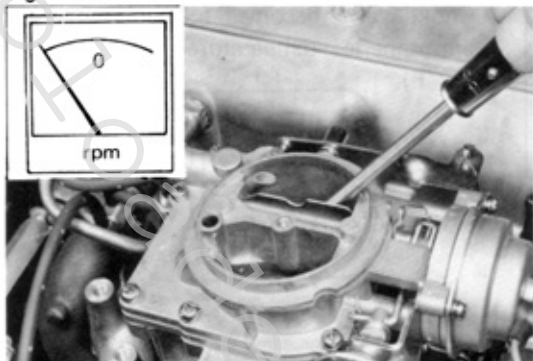
Fig. 2-39



AAP

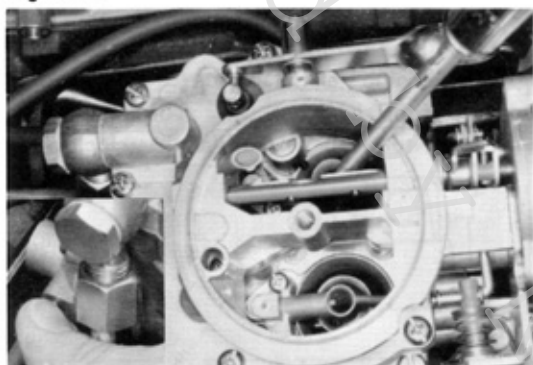
1. Start engine.
2. Pinching AAP hose.

Fig. 2-40



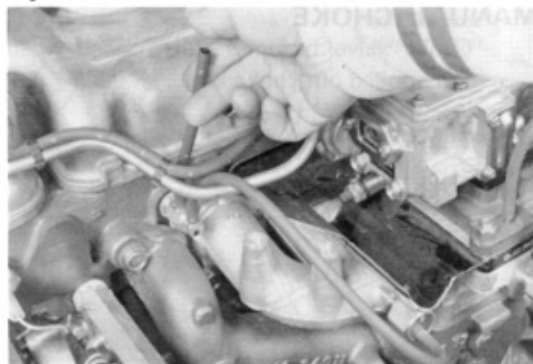
3. Stop engine and open choke valve.

Fig. 2-41



4. Gasoline should shurt out from accelerating jet when AAP hose released.

Fig. 2-42

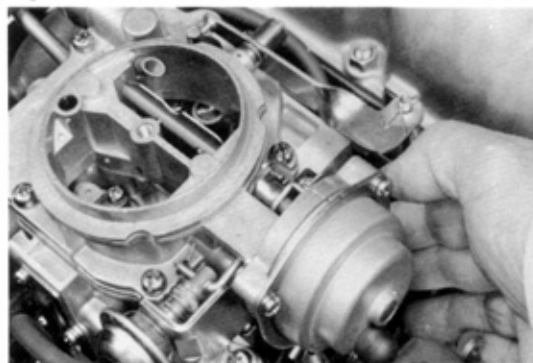


TVSV (for AAP)



1. Have engine idling. (below 60°C, 140°F)
2. When hose is disconnected from AAP diaphragm, engine should run rough idling.

Fig. 2-43

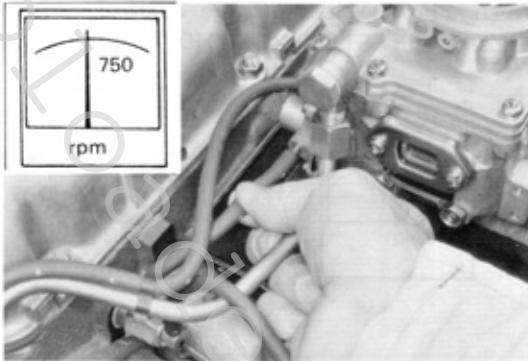


[HOT CONDITION] AUTOMATIC CHOKE



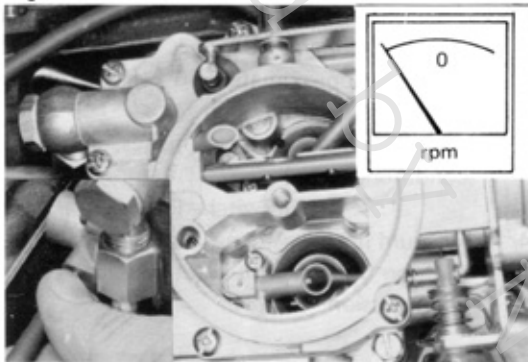
1. With engine warm up, choke valve should be open.

Fig. 2-44

**AAP**

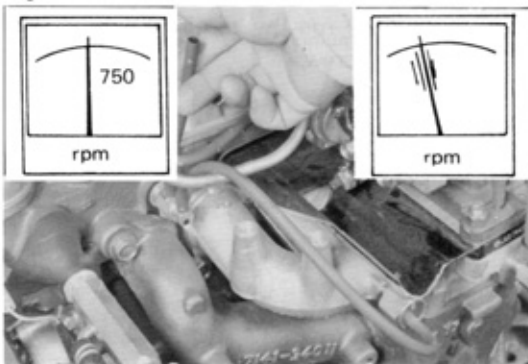
1. Start engine.
2. Pinching AAP hose.

Fig. 2-45



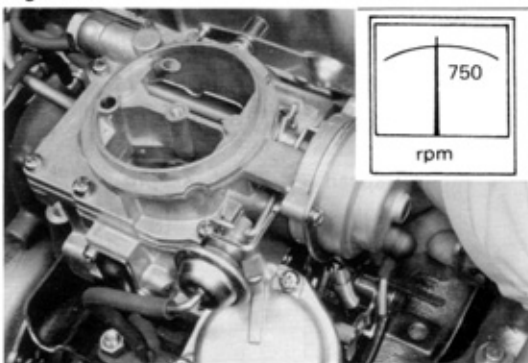
3. Stop engine.
4. Gasoline did not shut out from accelerating jet when AAP hose released.

Fig. 2-46

**TVSV (for AAP)**

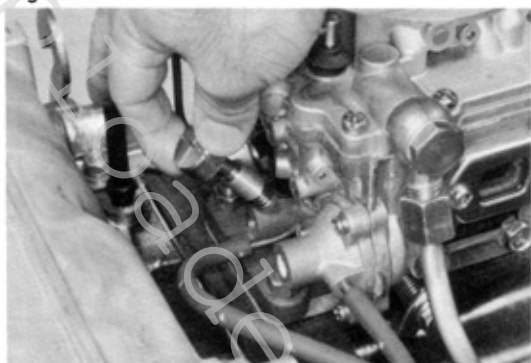
1. Have engine idling. (above 60°C, 140°F)
2. When hose is disconnected from AAP diaphragm, engine should run idling smoothly.

Fig. 2-47

**CHOKE BREAKER**

1. Have engine idling.
2. When hose is disconnected from intake manifold, check to see that choke breaker link is returned.
3. When hose is reconnected to intake manifold, check to see that the choke breaker link is pulled in by diaphragm. If defective, replace diaphragm.

Fig. 2-48



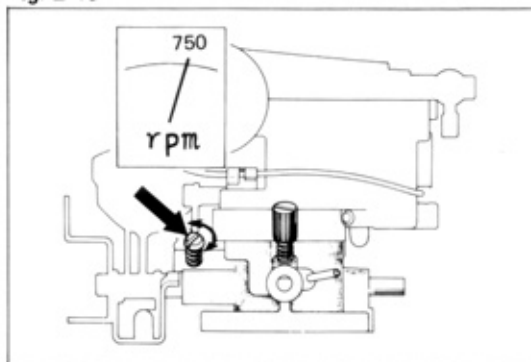
INITIAL IDLE SPEED

When adjusting idle mixture adjusting screw, adjust it with SST [09243-00010].

Check the following items beforehand.

1. Coolant temperature —
Approximately 80°C (180°F)
2. Choke valve — Full open
3. Accessory parts (wipers, heater, lights, air conditioner, etc.)
— All switched off.
4. Vacuum lines — All lines connected.
5. Ignition timing — Initial set position.
6. Transmission — In "N"

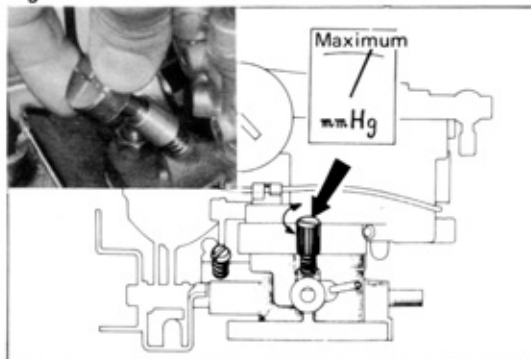
Fig. 2-49



BEST IDLE

1. Set to 750 rpm by turning the idle speed adjusting screw.

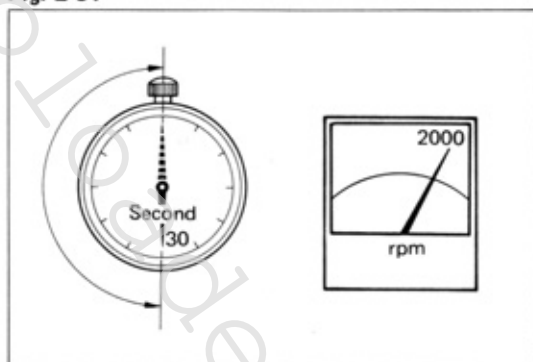
Fig. 2-50



2. Set to the maximum vacuum by turning the idle mixture adjusting screw.
3. Repeat the above adjustments until the specified rpm and maximum vacuum will be obtained.

Idle speed	750 ± 50 rpm
Vacuum	420 mmHg (16.5 inHg)

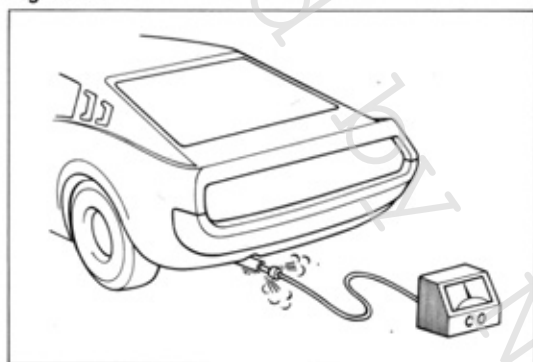
Fig. 2-51



CO CONCENTRATION

1. Measure the CO concentration.
 - (1) Be sure to race the engine before taking measurement. About 2,000 rpm for 30 ~ 60 seconds.

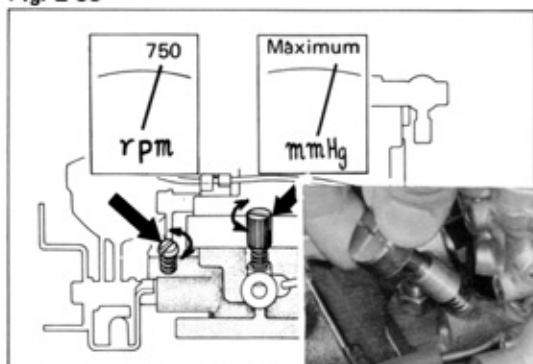
Fig. 2-52



- (2) Measure within 1 to 3 minutes after racing the engine to allow the concentration to stabilize.

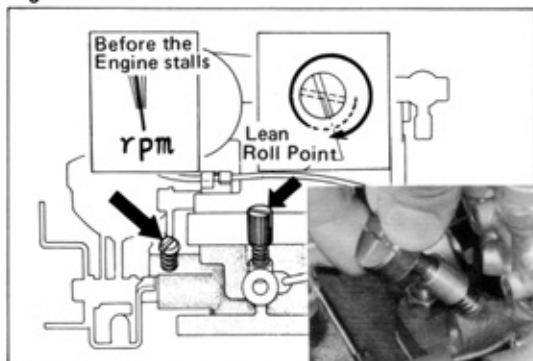
CO concentration Less than 1-3 %

Fig. 2-53



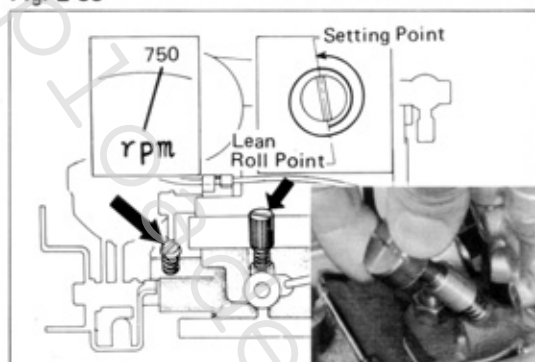
2. Adjust the CO concentration
 - (1) Set to 750 rpm by turning the idle speed adjusting screw.
 - (2) Set to maximum vacuum by turning the idle mixture adjusting screw.
 - (3) Repeat the above steps.

Fig. 2-54



- (4) Turn the idle mixture adjusting screw clockwise to obtain the lean roll point where the engine revolution becomes very rough; just before the engine stalls.

Fig. 2-55



- (5) Turn the idle mixture adjusting screw counter-clockwise about $1\frac{1}{2}$ turns to richer side.
- (6) Then adjust the idle speed adjusting screw to obtain the specified idle speed of 750 rpm.
- (7) Repeat the above steps.

Fig. 2-56

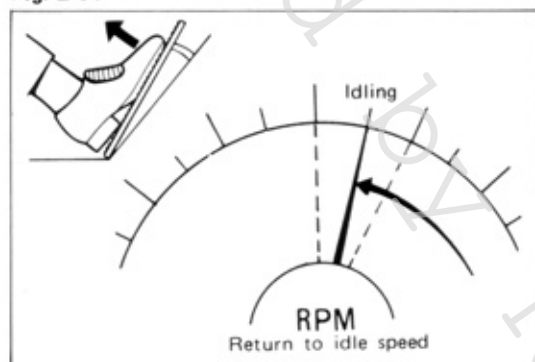


Fig. 2-57

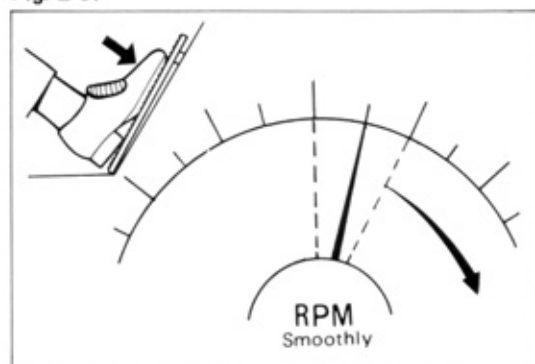
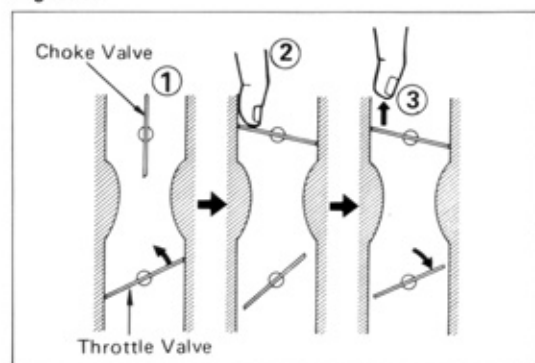


Fig. 2-58



ENGINE CONDITION



1. Check if the engine returns to idle speed when suddenly and slowly accelerated.



2. Opening throttle valve gradually should cause engine to speed up smoothly in relation to amount of valve opening.

FAST IDLE (Automatic Choke) ADJUSTMENT



1. Stop engine.
2. With the throttle valve slightly open, close the choke valve with finger, then close the throttle valve.
3. Start engine without stepping on the accelerator pedal.

Fig. 2-59

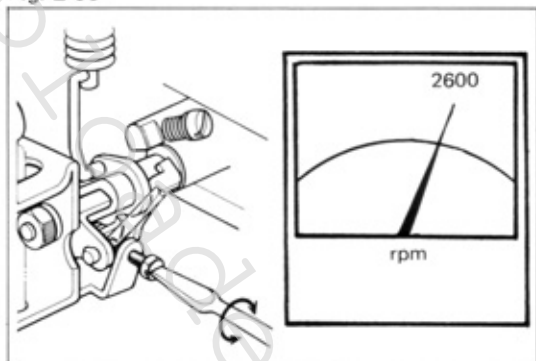


Fig. 2-60

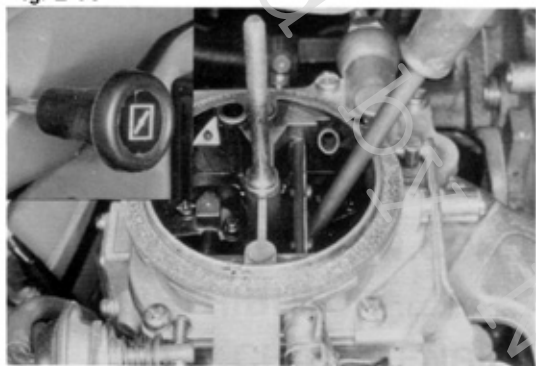


Fig. 2-61

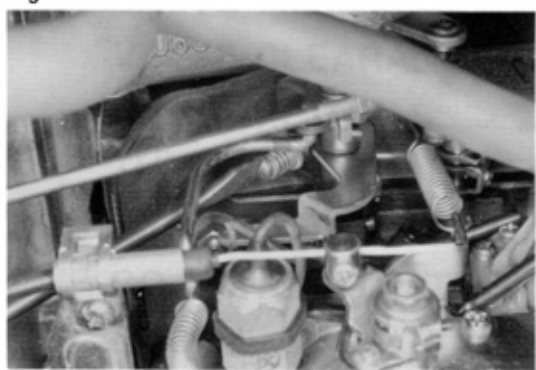
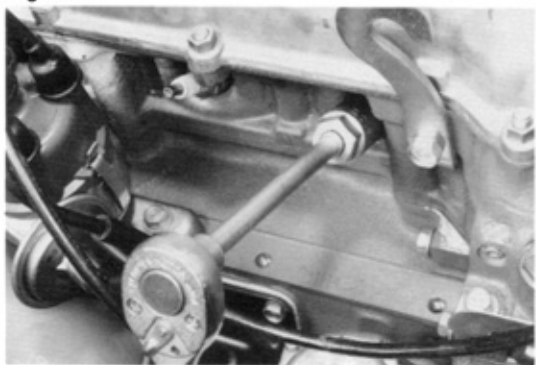


Fig. 2-62



4. Check the engine speed to see if it is the specified rpm.
5. If not, correct by turning the fast idle adjusting screw.

Fast idle speed **2600 ± 200 rpm**

FAST IDLE [Manual Choke] ADJUSTMENT



1. Pull choke knob fully.
2. Fully open choke valve with a screwdriver.

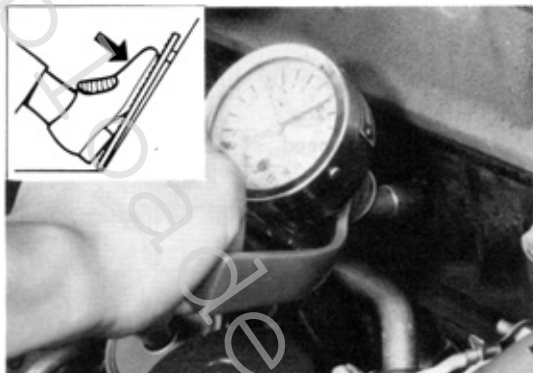
3. Start engine.
 4. Adjust by turning fast idle adjusting screw.
- Fast idle speed** **2600 ± 200 rpm**

COMPRESSION PRESSURE



1. Warm up the engine.
2. Remove all spark plugs.
3. Disconnect the high tension cord from ignition coil to cut-off the secondary circuit.

Fig. 2-63



4. Insert a compression gauge into the spark plug hole, open the throttle valve fully, and measure the compression pressure while cranking the engine with starter motor.

Compression Pressure**12.0 kg/cm² (170.4 psi)****Limit****9.0 kg/cm² (127.8 psi)****Difference of pressure between cylinder****1.0 kg/cm² (14.2 psi)**

18R-G ENGINE TUNE-UP

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18R-G ENGINE TUNE-UP ITEM

ITEM		REMARK
1	ENGINE OIL	
	Oil level check	"Full" line
	Oil replenishment	API service SE classification
	Oil capacity Total	4.7 liter 5.0 US qt. 4.1 Imp.qt.
	Crankcase	4.2 liter 4.4 US qt. 3.9 Imp.qt.
	Quality check	
2	COOLING SYSTEM	
	Oil filter replacement	SST [09228-44010]
	Coolant level check	"Full" line
	Quality check	
3	DRIVE BELT	
	Coolant capacity (w/heater)	9.1 liter 9.6 US qt. 8.0 Imp.qt.
	Tension Fan — Alternator	8 — 12 mm 0.31 — 0.47 in
	A/C Compressor —	
4	AIR CLEANER	
	Element cleaning	
5	BATTERY	
	Specific gravity	1.25 — 1.27 at 20°C 68°F
6	SPARK PLUG	
	Electrolyte level	
	Visual check	
	Cleaning	
7	HIGH TENSION CORD	
	Plug gap	0.9 — 1.0 mm 0.035 — 0.039 in
8	DISTRIBUTOR	
	Resistance	Less than 25 kΩ per cord
	Distributor cap	
	Point gap	0.45 mm
	Dwell angle	50 — 54°
	Dwell angle variation	within 3°
	Ignition timing	
	at Engine stop	5° BTDC
	Coolant 60°C below	20° BTDC (Reference only)
	Coolant 60°C above	5° BTDC/1000 rpm
9	NO.2 CHAIN TENSIONER	
	Governor operational	
10	VALVE TIMING	
	Vacuum operational	
11	VALVE CLEARANCE (COLD)	
	Back stroke	0.5 — 1.0 mm at 3 — 5 kg
		SST [09248-27010]
	Intake	0.26 — 0.32 mm 0.010 — 0.013 in
	Exhaust	0.31 — 0.37 mm 0.012 — 0.015 in

ITEM			REMARK
12	CARBURETOR	Float level	SST [09240-27010] 16 — 18 mm 0.63 — 0.71 in
	ACCELERATION PUMP	Fuel discharging time	0.8 — 1.1 second
		Fuel injection direction	
		Starter wire	50° (at rotally disc)
		Throttle valve full open	
	WARM UP ENGINE		
13	THROTTLE LINK	Idle speed	1000 ± 50 rpm
	(INITIAL IDLE SPEED)	Manifold vacuum	330 mm Hg 13.00 in Hg
		Vacuum difference	below 10 mm Hg 0.39 in Hg
14	BEST IDLE ADJUSTMENT	Idle mixture adjusting screw preset position	Screw out 1½ turn
		Best idle speed	1000 ± 50 rpm
		Manifold vacuum	above 330 mm Hg 13.00 in Hg
15	CO CONCENTRATION		0.5—0.9 %
16	ENGINE CONDITION		
17	COMPRESSION PRESSURE	Standard	13.0 kg/cm ² 184.6 psi
		Limit	10.0 kg/cm ² 142.0 psi
		Difference of pressure between cylinders	Less than 1.0 kg/cm ² 14.2 psi

Fig. 3-1

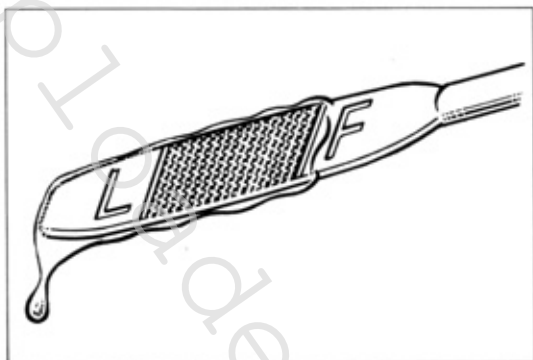


Fig. 3-2

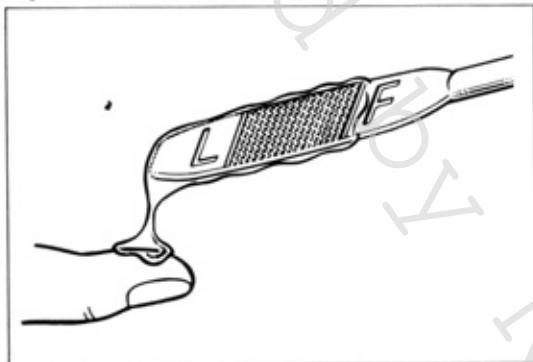


Fig. 3-3

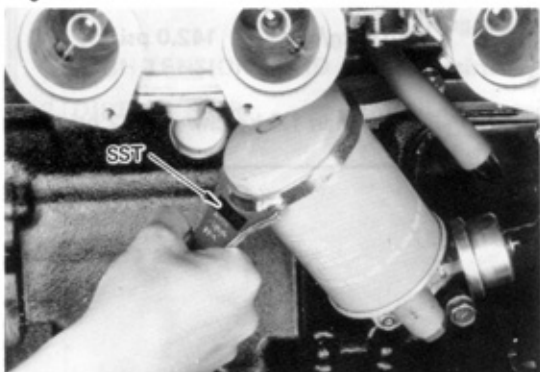


Fig. 3-4



ENGINE OIL



LEVEL CHECK and REPLENISHMENT

Oil level should be up to the F line on the level gauge. If low, add oil up to the F line. Use API service SE classification engine oil.



QUALITY CHECK

Pull out the oil level gauge and examine the oil adhering on the graduated part. The oil should not be discolored or thin.



OIL FILTER REPLACEMENT

1. Remove the oil filter by using SST [09228-34010].
2. For installation, tighten firmly the oil filter by hand.



3. After starting the engine, check for oil leak and recheck the oil level.

Fig. 3-5



Fig. 3-6



Fig. 3-7

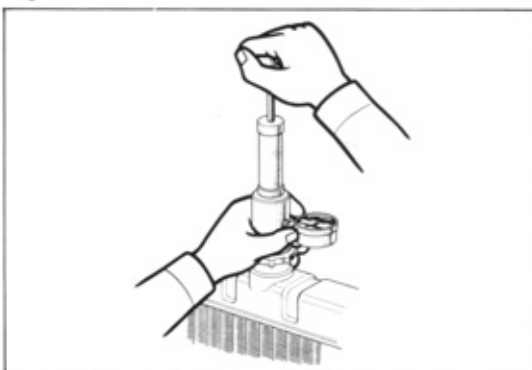
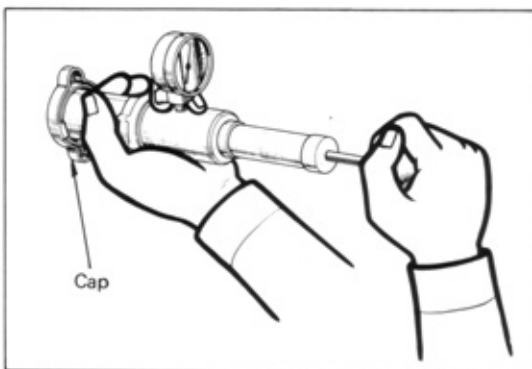


Fig. 3-8



COOLING SYSTEM

COOLANT LEVEL CHECK and REPLENISHMENT



If coolant is low, fill reservoir tank up to "Full" line.

COOLANT QUALITY CHECK



There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the coolant should also be free from oil. Replace the coolant if excessively dirty.

INSPECTION of COOLING SYSTEM PARTS



There should be no defects such as listed below:

1. Damage, deterioration, or loose clamps in radiator hoses, water hoses.
2. Leakage due to corrosion or damage in radiator core.
3. Leakage due to loose water drain cock.
4. Leakage from water pump.



5. Faulty operation of radiator cap. Inspect the radiator cap pressure regulating and vacuum valves for spring tension and seating condition. If the valve opens at a pressure level below the specified value or is otherwise defective, replace the radiator cap.

Valve opening pressure limit

0.6 kg/cm² (8.5 psi)

Standard

0.9 kg/cm² (12.8 psi)

Fig. 3-9



Fig. 3-10

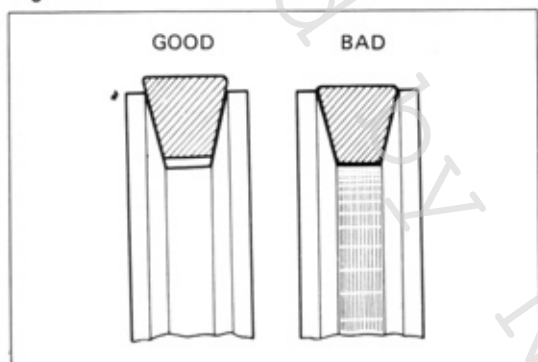


Fig. 3-11

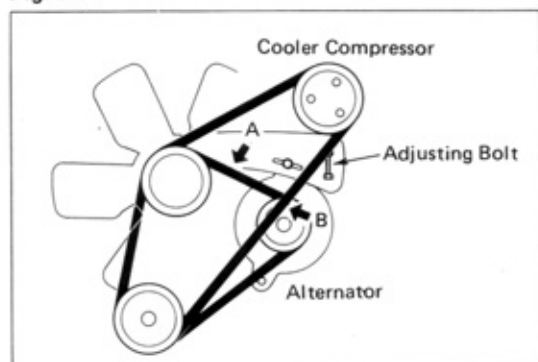


Fig. 3-12



DRIVE BELT VISUAL CHECK



There should be no defects such as listed below:

1. Cracked, deteriorated, stretched, or worn belt.
2. Adherence of oil or grease.



3. Improper contacting of belt against the pulley.

TENSION CHECK and ADJUSTMENT



When the belt is pressed down with 10 kg (22 lb) force, the belt should deflect the specified amount.

A : 8–12mm (0.32–0.47in)

B : 16–19mm (0.63–0.75in)



AIR CLEANER ELEMENT CLEANING

1. In removing the air cleaner or element, and after removal, use care not to drop dirt and dust down into the carburetor.
2. In cleaning the element, blow air from the inner side.
3. In case the element is torn or excessively dirty, replace with new one.

Fig. 3-13

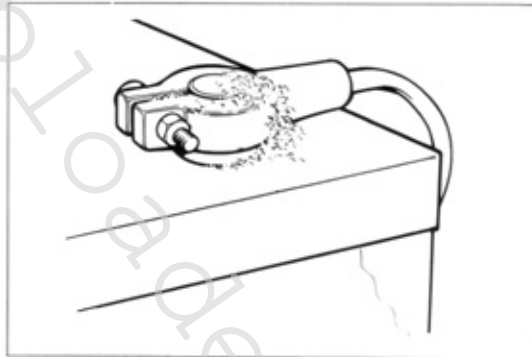


Fig. 3-14

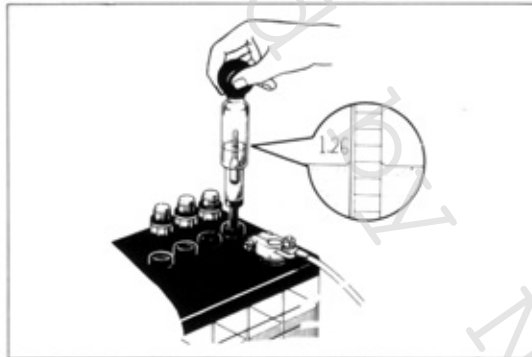


Fig. 3-15

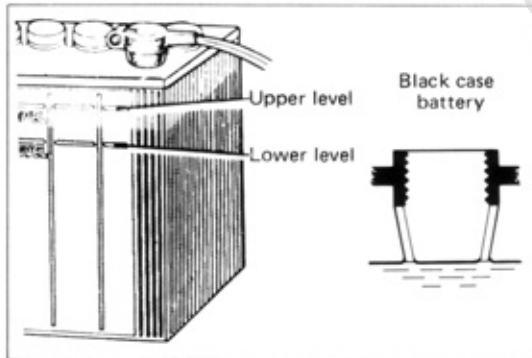
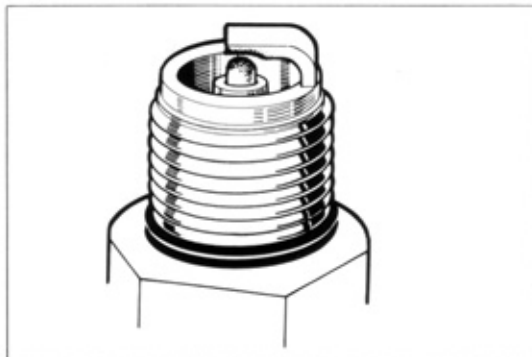


Fig. 3-16



BATTERY VISUAL CHECK

If very dirty, remove and clean before checking. There should be no defects such as listed below:

1. Rusted battery mounting hardware.
2. Damage or leakage in battery.
3. Loose connection, rusting, deterioration or corrosion of battery terminals.



SPECIFIC GRAVITY MEASUREMENT

Hold the hydrometer so that the float will not contact against the cylinder wall and read the graduation.

Specific gravity 1.25–1.27
at 20°C (68°F)



ELECTROLYTE LEVEL CHECK and REPLENISHMENT

The electrolyte level should be up to the upper level. If low, add distilled water (or purified water).



SPARK PLUG VISUAL CHECK

Condition is good if none of the following defects are present:

1. Cracks or damages in the threads or insulator.
2. Wear on the electrodes.
3. Damaged or deteriorated gaskets.
4. Burnt condition of electrode and undesirable carbon deposit.

Fig. 3-17

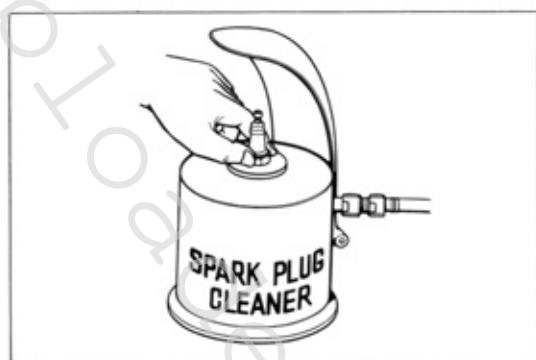


Fig. 3-18

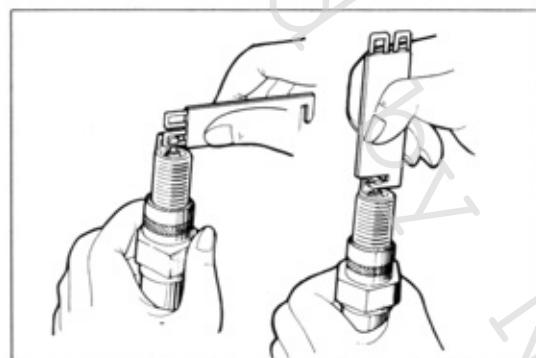


Fig. 3-19

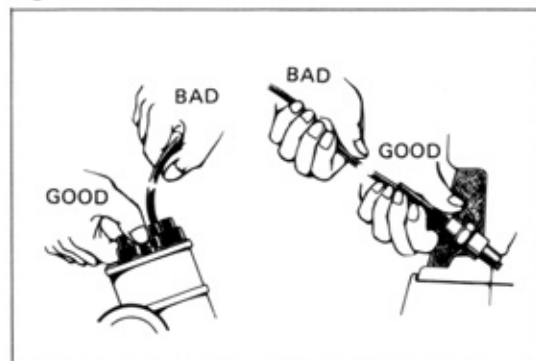
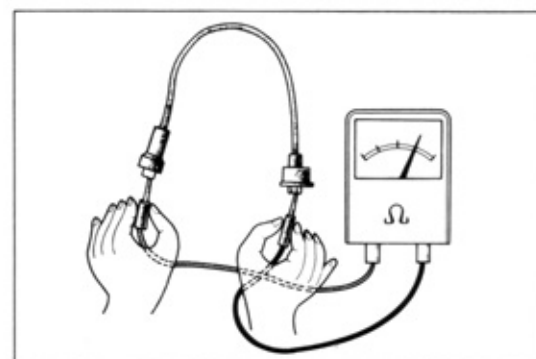


Fig. 3-20



CLEANING



1. Do not use spark plug cleaner longer than necessary.
2. Blow off cleaning compound and carbon on the threads thoroughly with air.
3. Clean off dirt from the outer surface of insulator and threads.

GAP ADJUSTMENT



Check the plug gap with plug gap gauge. If not to specified value, adjust by bending the ground (outer) electrode.

Plug gap 1.0 mm (0.039 in)

HIGH TENSION CORD



— Note —

When pulling out the spark plug cord from the plug, always grip the end of plug cord.



Check the resistance of resistivity cord.

Resistance Less than 25 kΩ per cord.

Fig. 3-21

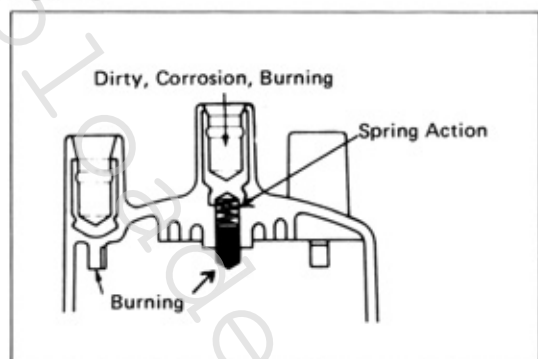


Fig. 3-22

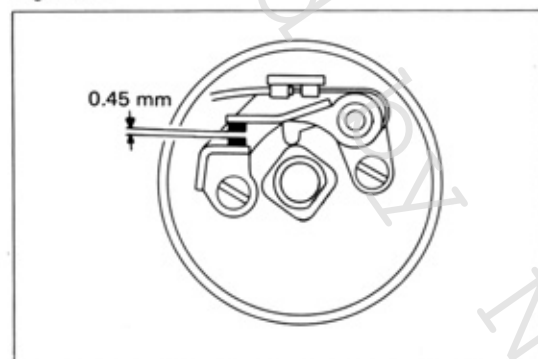


Fig. 3-23

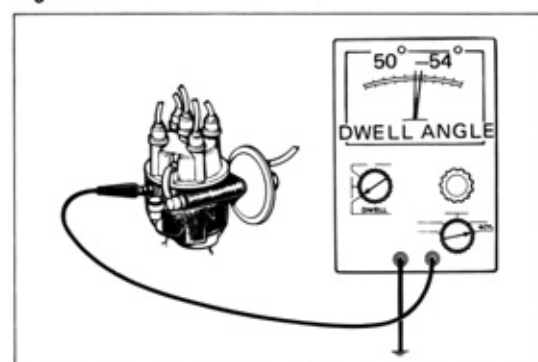
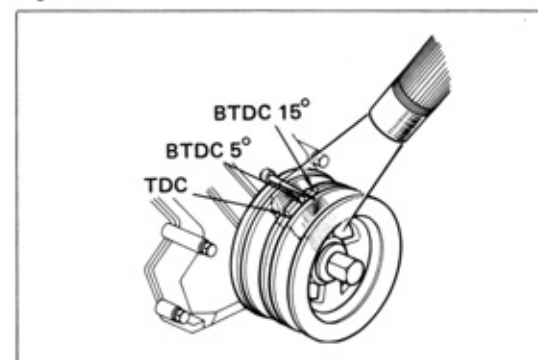


Fig. 3-24



DISTRIBUTOR

CAP INSPECTION

Clean the distributor cap and inspect the cap and rotor for:

1. Cracks, damage, dirty cord hole, corrosion, burning.
2. Center piece spring action.
3. Burnt electrode terminal.

POINT GAP ADJUSTMENT

1. If the points are excessively burnt or pitted, replace the breaker points.
2. Adjust point gap.

Point gap 0.45 mm (0.018 in)

DWELL ANGLE

Check if dwell angle is within the specified value.

Dwell angle 50–54°

Variation Within 3° (at idling to 2000 rpm)

IGNITION TIMING

INSPECTION

Set the engine revolution at idle speed, the octane selector must be set at standard position.

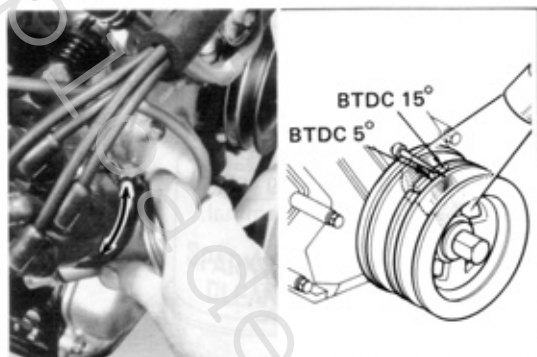
Ignition timing

at Engine Stop 5° BTDC

Coolant 60°C below 20° BTDC (Reference only)

Coolant 60°C above 5° BTDC/1000rpm

Fig. 3-25

**ADJUSTMENT**

Align the timing marks by turning distributor body.

Ignition timing

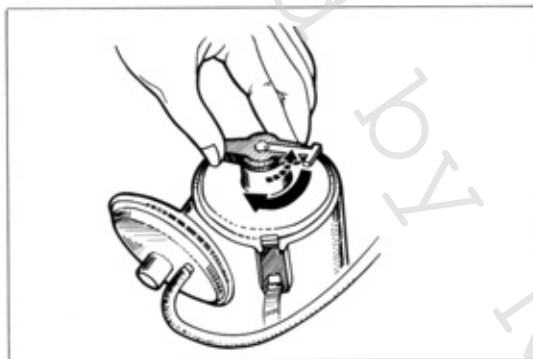
Coolant above 60°C

5° BTDC/1000 rpm

Coolant below 60°C

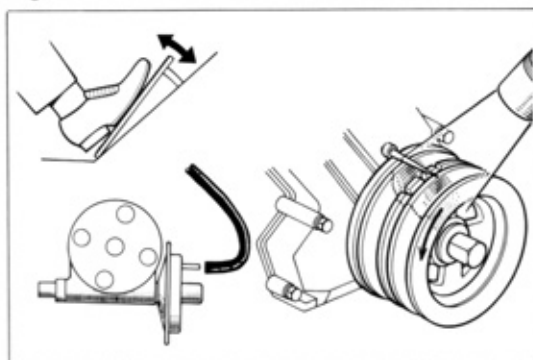
20° BTDC (Reference only)

Fig. 3-26

**GOVERNOR OPERATIONAL INSPECTION**

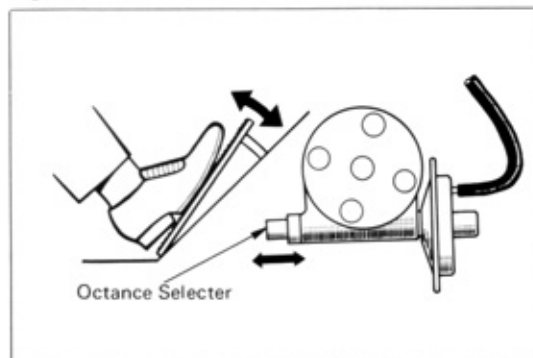
1. Rotor should return quickly when turned clockwise by hand and released.
2. Rotor should not be excessively loose.

Fig. 3-27



3. Start the engine and disconnect the vacuum hose from the distributor. The timing mark should vary in accordance with the opening and closing of throttle valve.

Fig. 3-28

**VACUUM ADVANCE OPERATIONAL INSPECTION**

Connect the distributor vacuum hose.

The octane selector should vary in accordance with the opening and closing of throttle valve.

Fig. 3-29

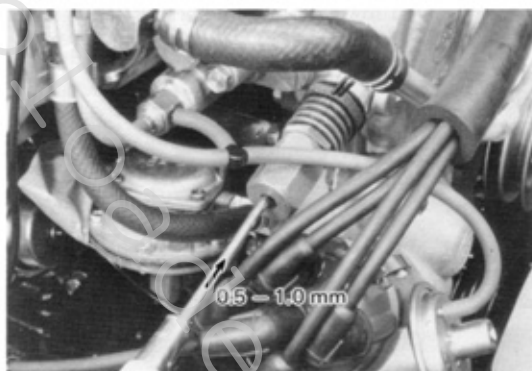


Fig. 3-30

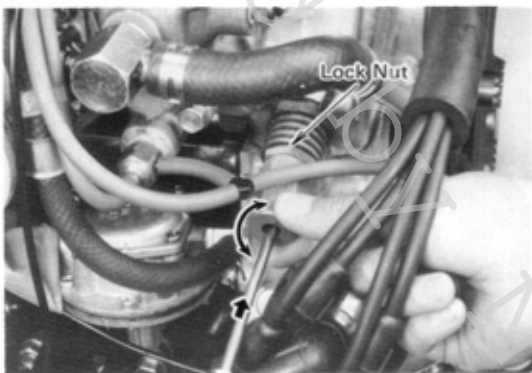


Fig. 3-31

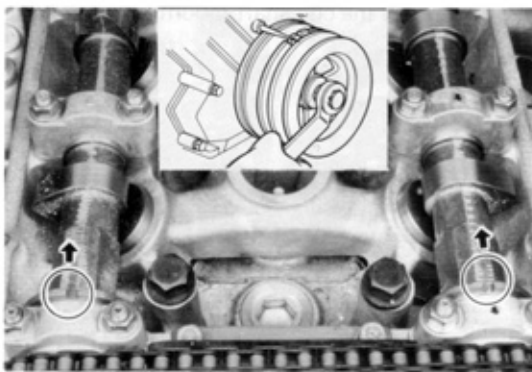
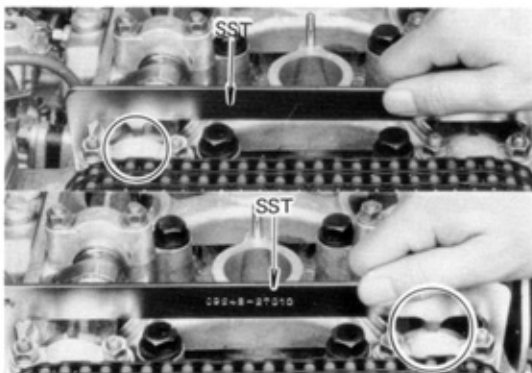


Fig. 3-32



NO.2 CHAIN TENSIONER CHECK THE BACK STROKE

Press down the plunger with 3–5kg (6.6–11.0lb) force and measure the stroke.

Stroke 0.5–1.0mm (0.02–0.04in)



ADJUSTMENT

1. Loosen the lock nut.
2. Press the plunger with 3 ~ 5kg (6.6 ~ 11.0 lbs) force and screw in the adjust nut until it rests on the plunger.
3. Unscrew the adjust nut 1/3~2/3 turns and secure it with lock nut.
4. Check the stroke to see that it is within the specified value.

VALVE TIMING INSPECTION

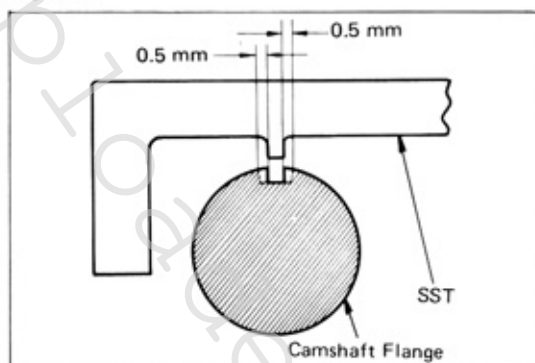


1. Remove the engine cylinder head cover.
2. Set No. 1 cylinder to TDC/compression. At TDC compression position, timing check slits in the flange of camshafts are positioned upward.



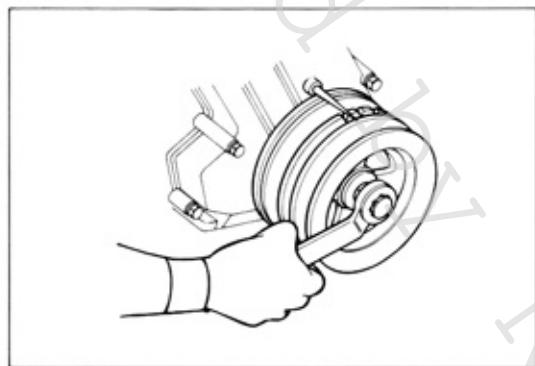
3. Check the positions of camshaft No. 1 and No. 2.
Use SST [09248-27010].

Fig. 3-33



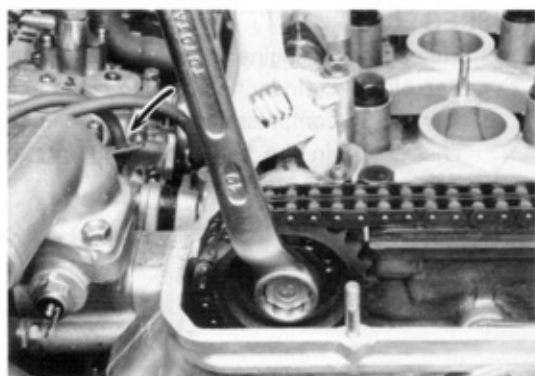
4. Valve timing permissible error
 $\pm 2^\circ$ Camshaft rotation angle.
 $\pm 0.5\text{mm}$ (0.020in)
 Camshaft flange outer perimeter.

Fig. 3-34

**ADJUSTMENT**

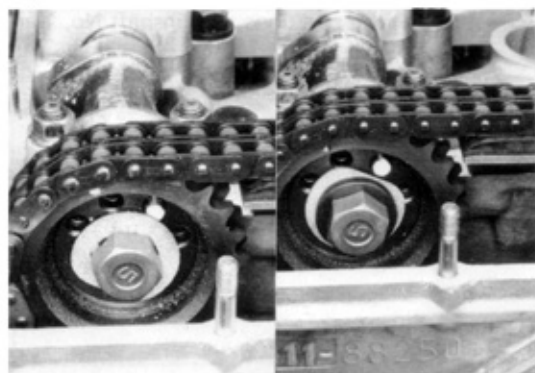
1. Reset No. 1 cylinder TDC/compression.

Fig. 3-35



2. Loosen the camshaft mounting bolt.

Fig. 3-36



3. Shift the washer.

Fig. 3-37

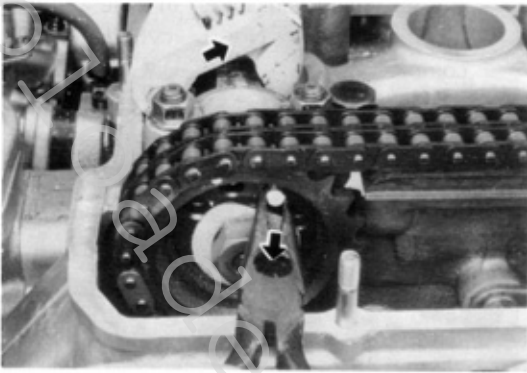


Fig. 3-38

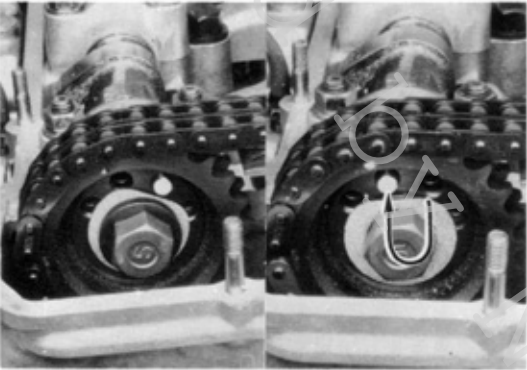


Fig. 3-39

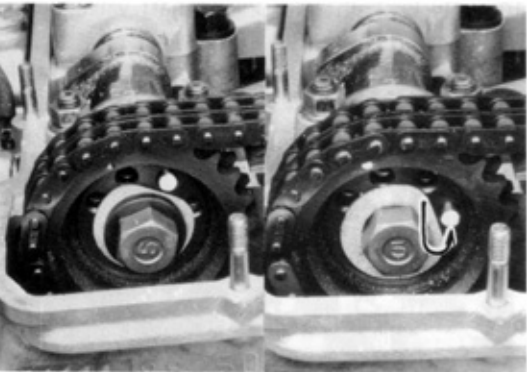
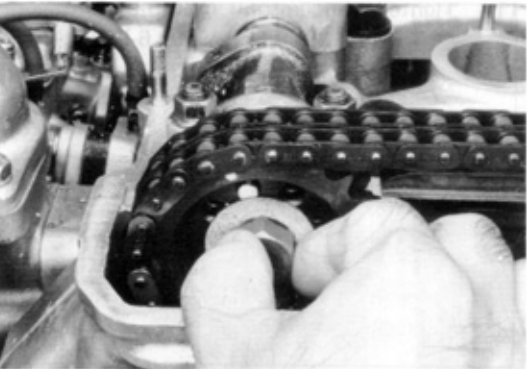


Fig. 3-40



4. It will be easier to pull out the pin if the camshaft is turned slightly in the forward direction so as to provide play.

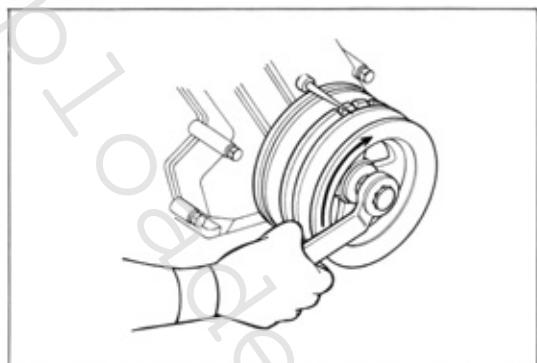
5. When valve timing is advanced.
- (1) Align with pin hole in counterclock wise direction.
 - (2) Turn the camshaft so that its slit will be lined up with the adjust gauge and reinsert the pin.

6. When valve timing is retarded
- (1) Align with hole pin in clock wise direction.
 - (2) Turn the camshaft so that its slit will be lined up with the adjust gauge and reinsert the pin.



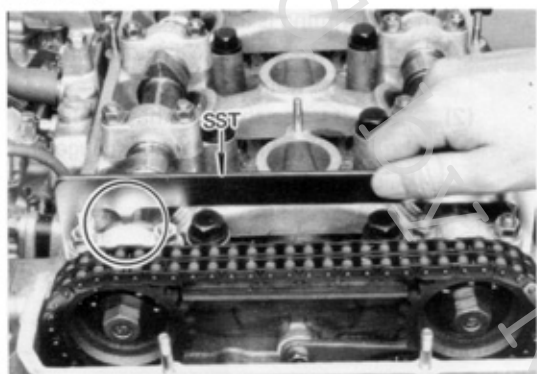
7. Hold the pin with the washer and tighten the bolt.

Fig. 3-41



8. Rotate the crankshaft in the normal direction until No. 1 cylinder TDC/compression.

Fig. 3-42



9. Recheck the No. 1 camshaft valve timing with SST [09248-27010]. Camshaft slit and SST protrusion should match up.

Fig. 3-43



10. Recheck the No. 2 camshaft valve timing with SST [09248-27010]. Camshaft slit and SST protrusion should match up.

Fig. 3-44



11. Tighten the camshaft mounting bolt.
Torque 7.0-8.0kg-m (50.6-57.9ft-lb)

Fig. 3-45

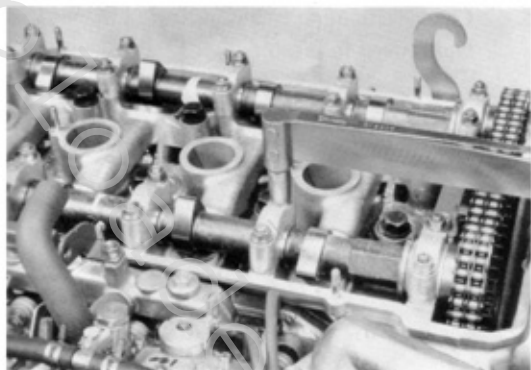


Fig. 3-46

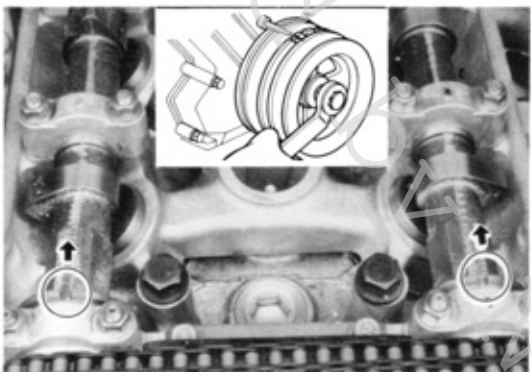


Fig. 3-47

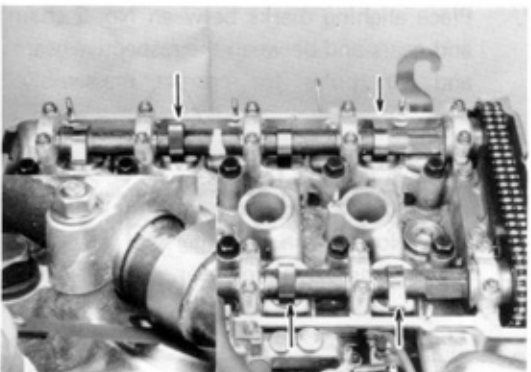
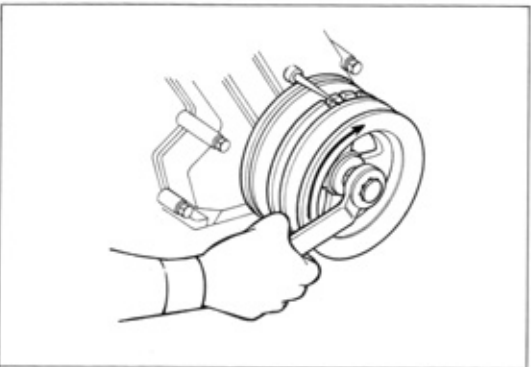


Fig. 3-48



VALVE CLEARANCE

(THE ENGINE SHOULD BE IN COLD CONDITION)

INSPECTION



1. Make sure of the following.

- (1) Camshaft bearing cap. 1.2-1.8kg-m (8.7-13.0ft-lb)
- (2) Valve timing. Use SST [09248-27010].



2. Set No. 1 cylinder to TDC/compression. In this condition, timing check slits in the flange of camshafts are positioned upward.



3. Measure only valve clearance indicated by arrows and record the results.

Clearance

Intake 0.26-0.32 mm (0.010-0.013 in)

Exhaust 0.31-0.37 mm (0.012-0.015 in)



4. Rotate crankshaft 360° in the normal direction until No. 4 cylinder TDC/compression.

Fig. 3-49

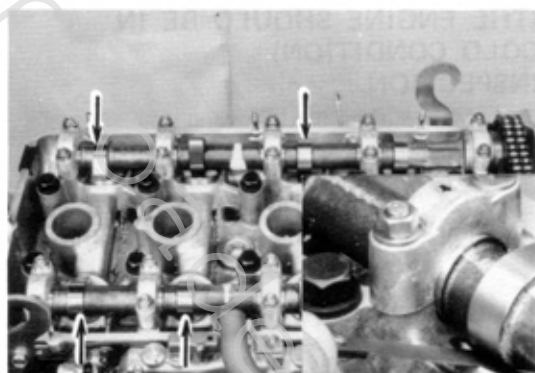


Fig. 3-50

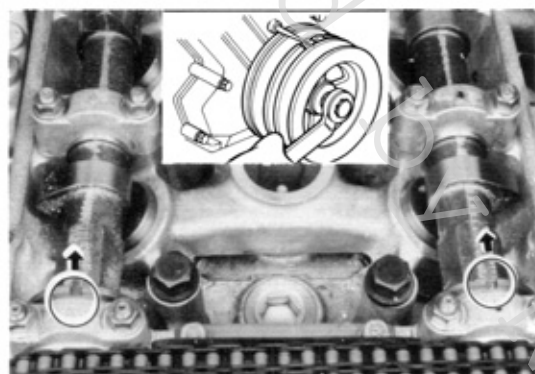


Fig. 3-51

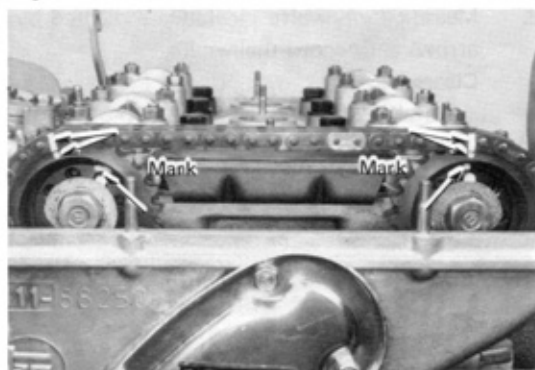
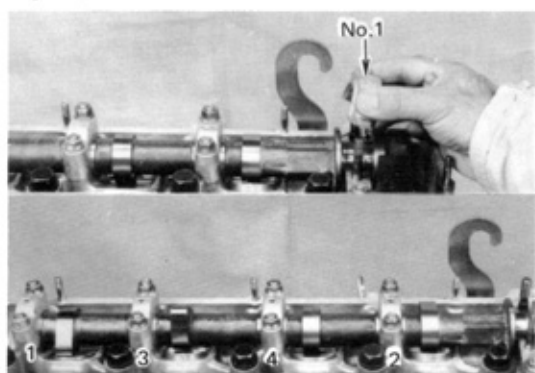


Fig. 3-52



5. Check remaining valves indicated by arrows and record the results.

ADJUSTMENT



In case any of the measured valves are not within the specified values.

1. Set No. 1 cylinder to TDC/compression.



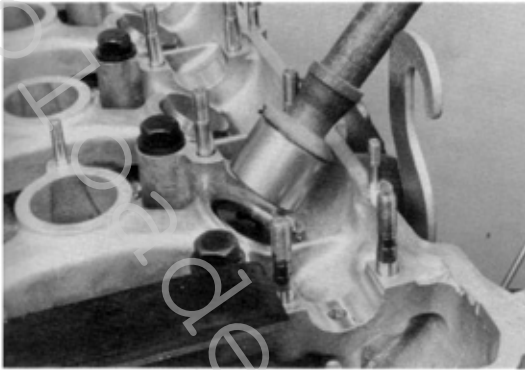
2. Place aligning marks between No. 2 chain and gears and between the respective gears and pin holes for correct reassembly.

3. Remove parts as follows.
 - (1) No. 2 chain damper.
 - (2) No. 2 chain tensioner.
 - (3) Camshaft timing gear.



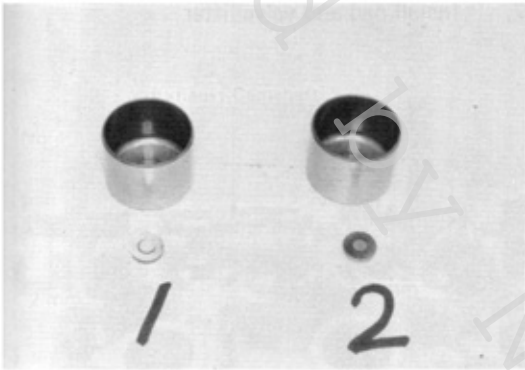
- (4) Camshaft No. 1 bearing cap.
- (5) Gradually loosen No. 2 to No. 5 bearing cap nuts in 2 to 3 stages in the sequence as shown.
- (6) Camshaft.

Fig. 3-53



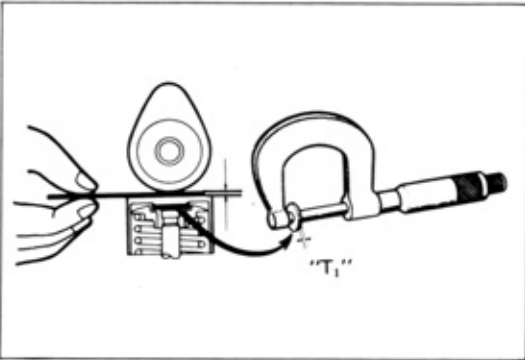
4. Remove valve lifter when valve clearance is not within specified valve.

Fig. 3-54



5. Keep valves and adjusting pads in order.

Fig. 3-55



6. Select a new pad that will give the specified valve clearance as follows.

- (1) Measure the pad that was off with a micrometer.



- (2) Calculate thickness of new pad so valve clearance comes within specified valve.

T₁..... Thickness of pad used

A Valve clearance measured

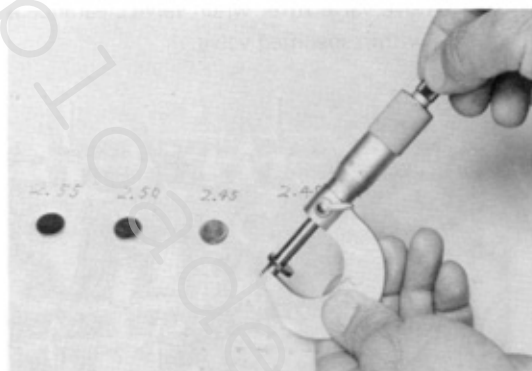
Intake Side

$$\text{New Pad Thickness} = T_1 + (A - 0.29\text{mm})$$

Exhaust Side

$$\text{New Pad Thickness} = T_1 + (A - 0.34\text{mm})$$

Fig. 3-56



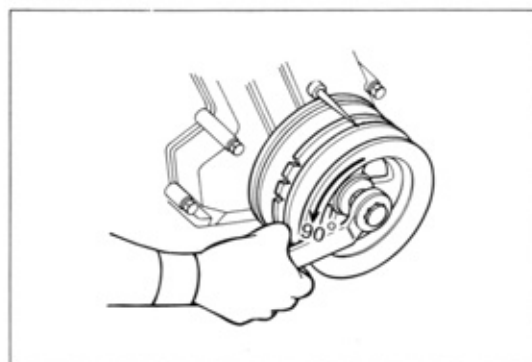
- (3) Select a pad with a thickness as close as possible to the valve calculated. Pads are available in 41 sizes, in increments of 0.05 mm (0.002 in), from 1.00 mm (0.039 in) to 3.00 mm (0.118 in).

Fig. 3-57



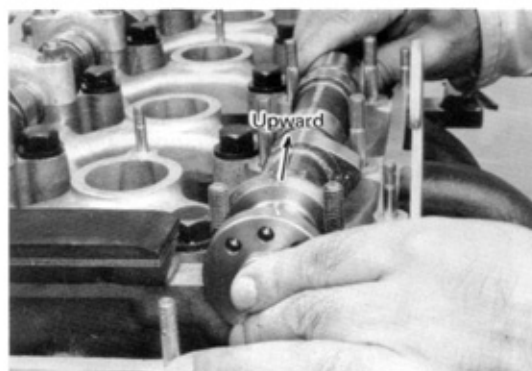
7. Install pad and valve lifter

Fig. 3-58



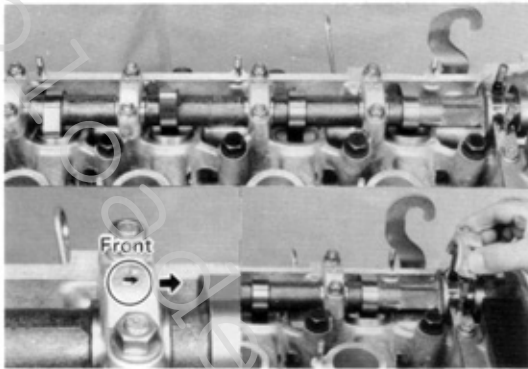
8. Install the camshaft
 (1) Rotate the crankshaft about 90° the reverse direction.
 — Caution —
 Lower piston to prevent interference of piston head and valve.

Fig. 3-59



- (2) Position slit of camshaft upward as shown.

Fig. 3-60

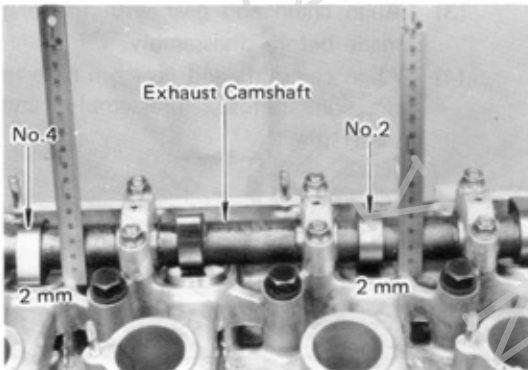


- (3) Install the No. 2 to No. 5 camshaft bearing caps.
Face the arrow mark toward front.
- (4) Gradually tighten bearing cap nuts in 3 to 4 stages in the sequence as shown.

Torque 1.7-2.3 kg-m (12.3-16.6 ft-lb)

- (5) Then tighten No. 1 bearing cap to 1.2-1.8kg-m (8.7-13.0ft-lb).

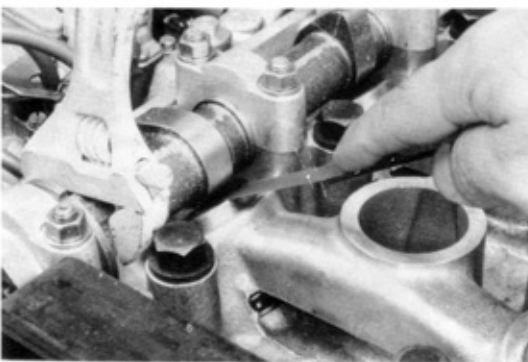
Fig. 3-61



9. Recheck intake side valve clearance.

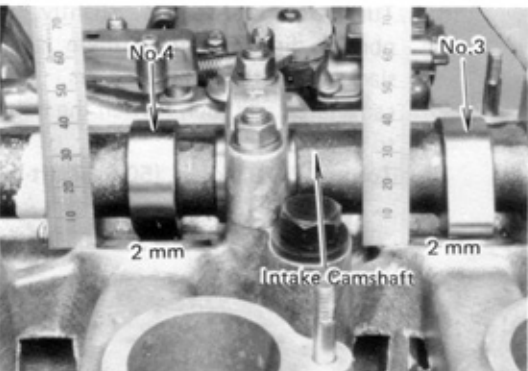
- (1) Exhaust side valve lifter No. 2 and No. 4 should protrude the same amount (approx. 2 mm)

Fig. 3-62



- (2) Measure intake side valve clearance.
If outside the specified valve, choose another pad.

Fig. 3-63



10. Recheck exhaust side valve clearance.

- (1) Intake side valve lifter No. 3 and No. 4 should protrude the same amount.
- (2) Measure exhaust side clearance.
If outside the specified value, choose another pad.

Fig. 3-64

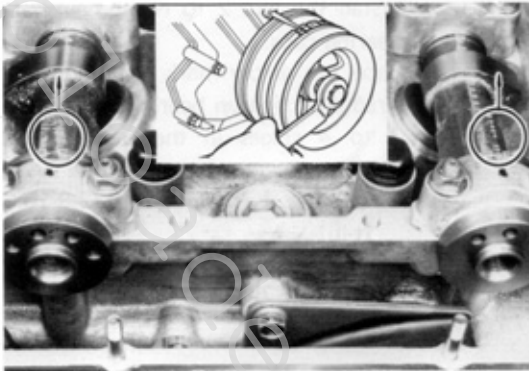


Fig. 3-65

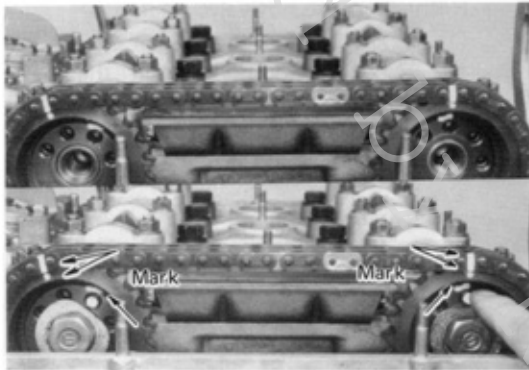


Fig. 3-66

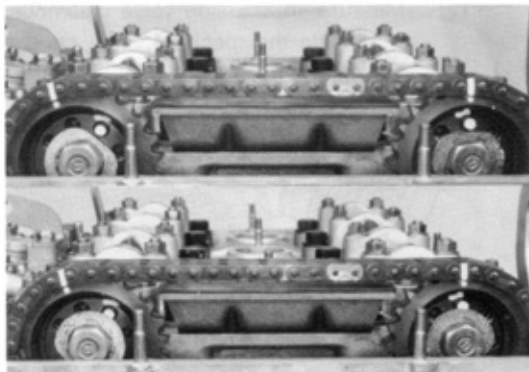
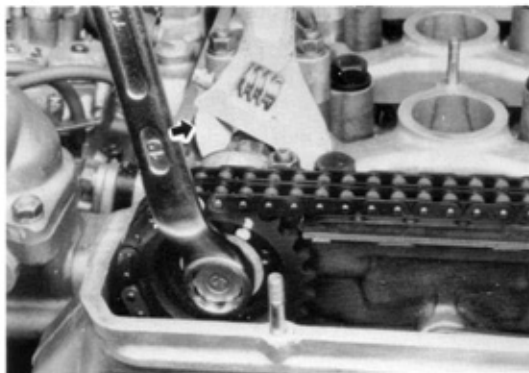


Fig. 3-67



11. Install the No. 2 chain and camshaft gears.
 - (1) Position the No. 1 and No. 2 camshaft slit vertically upward with SST [09248-27010].
 - (2) Set the No. 1 cylinder to TDC/compression.



- (3) Align chain and gear with marking made before disassembly.
- (4) Align camshaft and gear pin hole to position before disassembly and insert pin.



- (5) Hold the pin with the washer.



- (6) Turn the crankshaft slightly in normal direction, until there is no slack in the pins, gears, and camshafts, and then tighten the bolts to specified torques.

Torque 7.0-8.0kg-m (50.6-57.8ft-lb)

Fig. 3-68

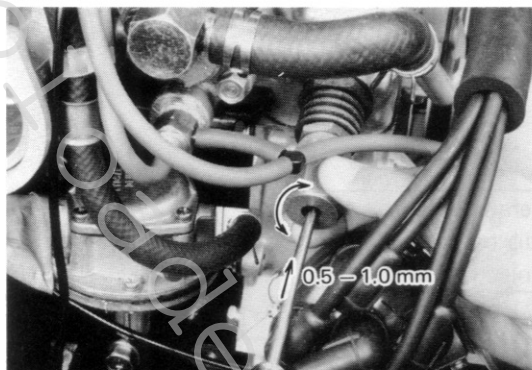


Fig. 3-69

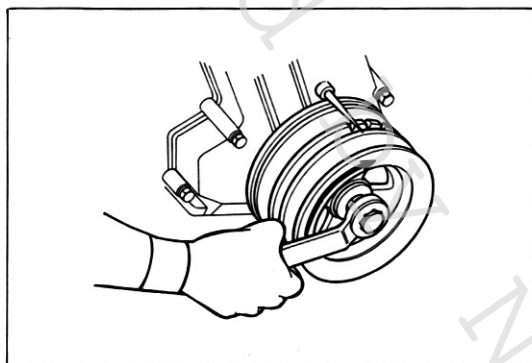
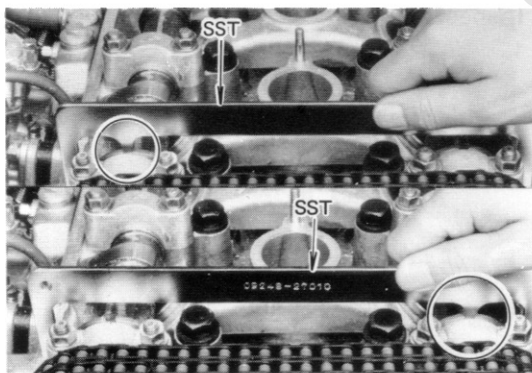


Fig. 3-70



- (7) Adjust the No. 2 chain tensioner.
Back stroke 0.5-1.0mm (0.02-0.04in)
at 3-5kg (6.6-11lb)



12. Recheck valve timing.

- (1) Rotate the crankshaft two turn in normal direction until No. 1 cylinder TDC/comperssion.



- (3) Recheck valve timing with SST [09248-27010].

CARBURATOR

CARBURATOR ADJUSTMENT PROCEDURES

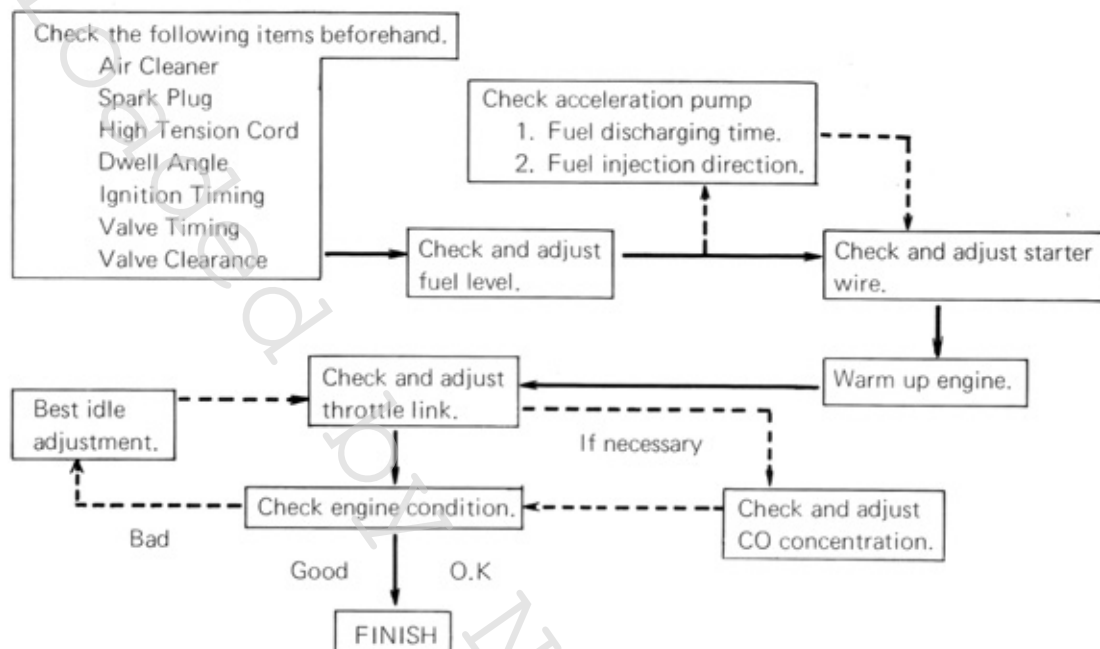


Fig. 3-71

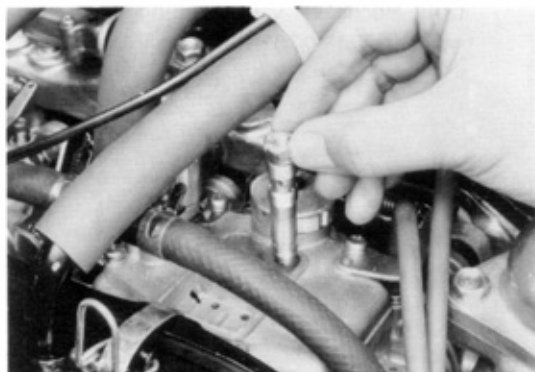
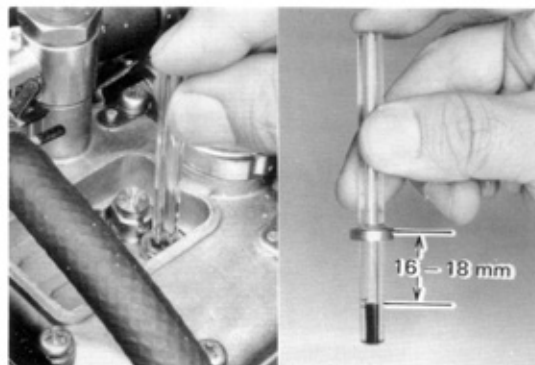


Fig. 3-72



FLOAT LEVEL

Inspection



1. Start the engine and idle.
About 1000rpm
2. Take out one of the main jet holders in assembled form.



3. Insert SST [09240-27010] in the hole from which the main jet holder was removed.
4. Check the gasoline level inside the gauge to see if within the limit.

Standard level 16-18mm (0.63-0.71in)

Fig. 3-73

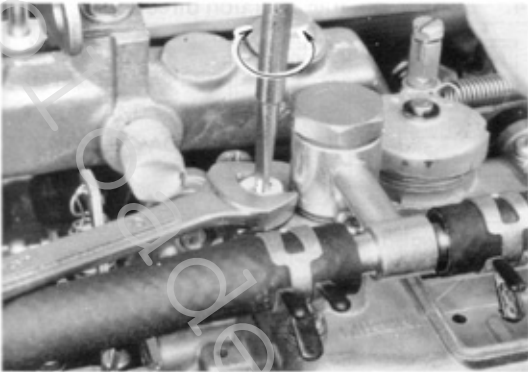


Fig. 3-74

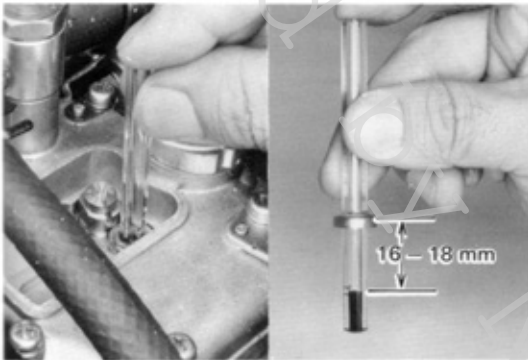
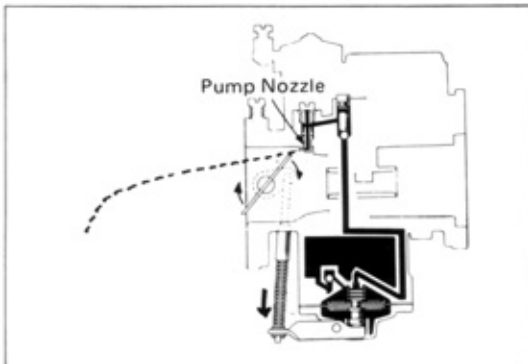


Fig. 3-75



Fig. 3-76

**ADJUSTMENT**

1. Adjust by turning the float level adjusting screw.

One turn

Float level change to 1.8mm (0.07in)



2. Recheck the float level.
Condition where the fuel pump is operating and applying fuel pressure.

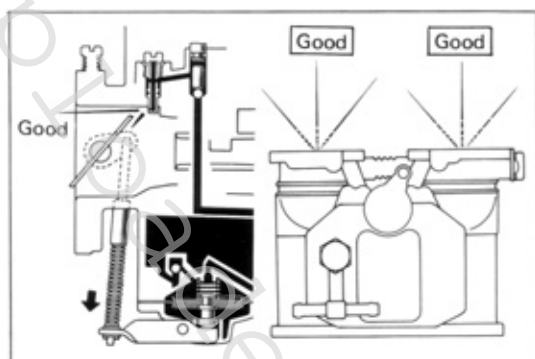
ACCELERATION PUMP INSPECTION

1. Remove the carburetor.
2. Check the fuel in the float chamber.



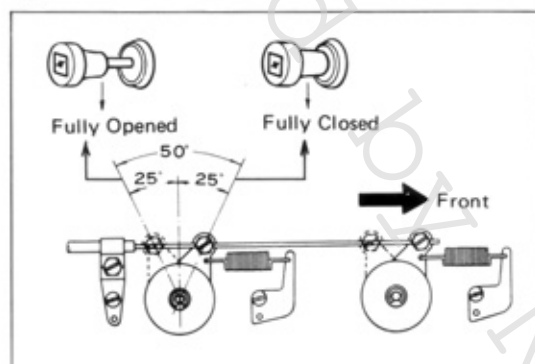
3. Check the fuel discharging time
0.8-1.1 second

Fig. 3-77



4. Check the fuel injection direction.

Fig. 3-78



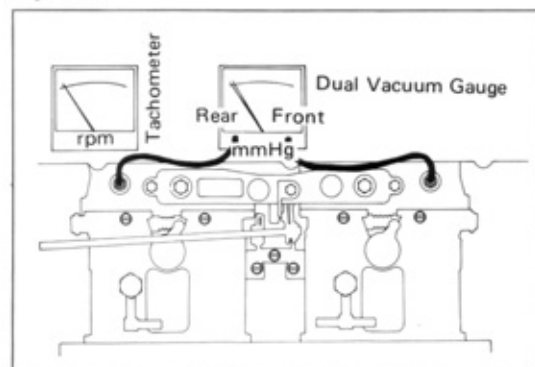
STARTER WIRE

THROTTLE LINK (INITIAL IDLE SPEED) INSPECTION

Check the following items beforehand.

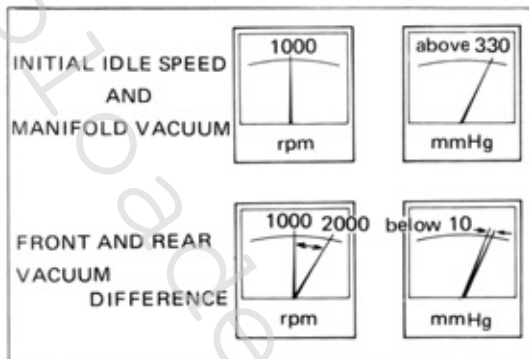
1. Coolant temperature 80°C (180°F)
2. Accessory parts All switched off.

Fig. 3-79



3. Mount the tachometer and the dual vacuum gauge to the vacuum take-off connection on the No. 1 and No. 4 intake manifolds.

Fig. 3-80



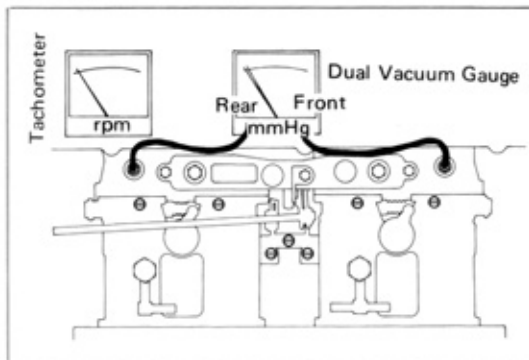
4. Check the idle speed and the difference between front and rear manifold vacuum.
- Idle speed** **1000 ± 50rpm**
- Manifold Vacuum** **330mmHg (13.00inHg)**
- Front and Rear Vacuum Difference (idle to 2000 rpm)** **below 10mmHg (0.39inHg)**

ADJUSTMENT

Check the following items beforehand.

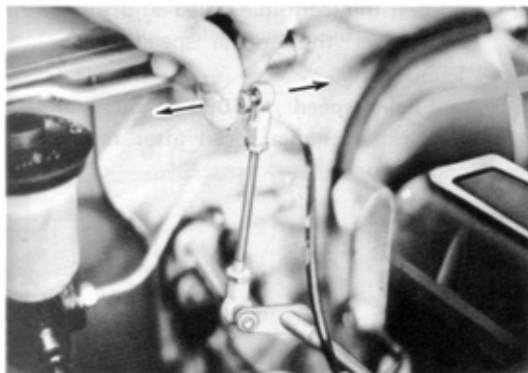
1. Coolant temperature 80°C (180°F)
2. Accessory parts All switched off.

Fig. 3-81



3. Mount the tachometer and the dual vacuum gauge to the vacuum take-off connection on the No. 1 and No. 4 intake manifolds.

Fig. 3-82



4. Disconnect the connecting rod at the body.

Fig. 3-83

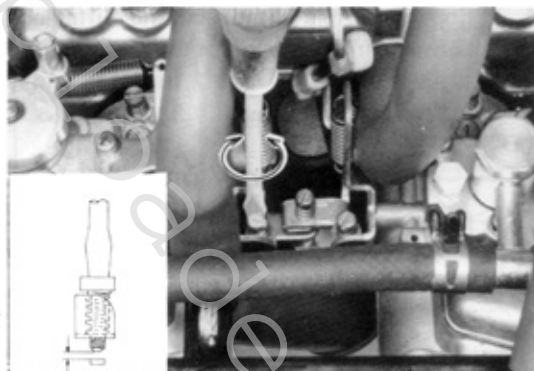


Fig. 3-84

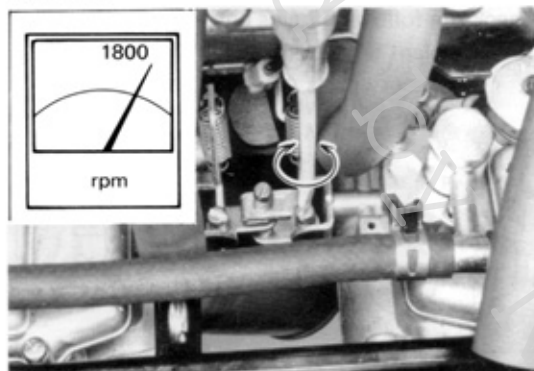


Fig. 3-85

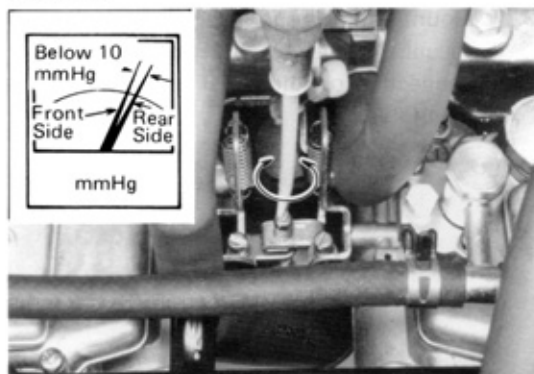
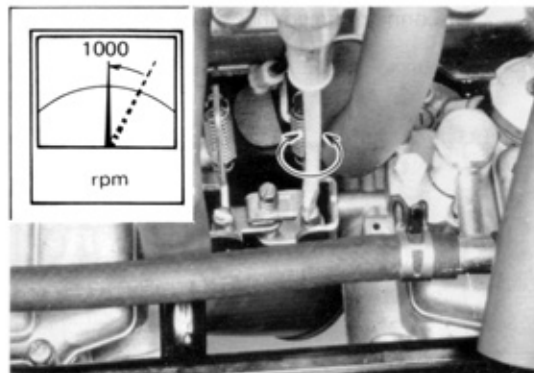


Fig. 3-86



5. Loosen the rear idle speed adjusting screw until it is free from the lever.

6. Set to 1800rpm by turning the front idle speed adjusting screw.

Engine speed 1800 rpm

Check the engine speed after raising the engine speed.

7. Set to front-rear vacuum difference to within 10mmHg (0.39inHg) by turning the synchronizing screw.

Front and rear vacuum difference below 10mmHg (0.39inHg)

Check the vacuum difference after raising the engine speed.

8. Loosen the front idle speed adjusting screw and lower the engine speed to 950 ~ 1,050 rpm.

Engine speed 1000 ± 50 rpm

Check the engine speed after raising the engine speed.

Fig. 3-87

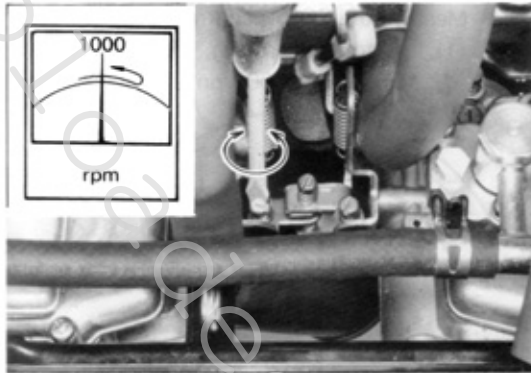


Fig. 3-88

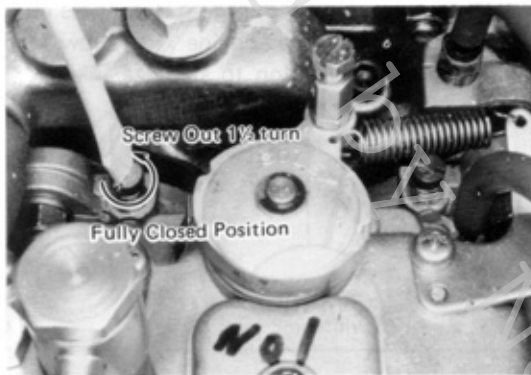


Fig. 3-89

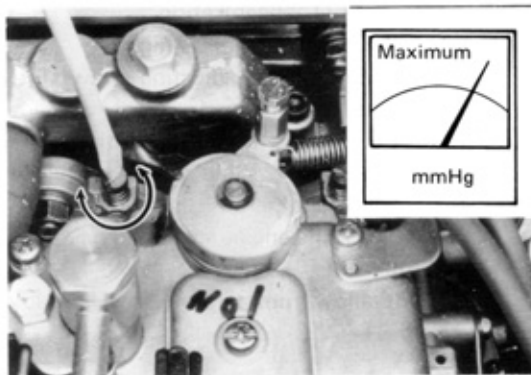
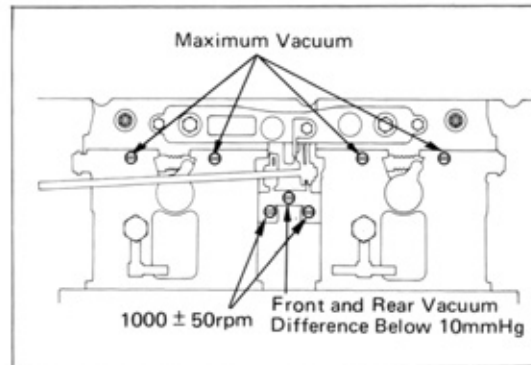


Fig. 3-90



9. Screw in the slightly the rear idle speed adjusting screw and raise the engine speed, then adjust the engine speed to 950 ~ 1050 rpm.

Engine speed 1000 ± 50rpm

Check the engine speed after raising the engine speed.

10. Readjust front-rear vacuum difference.

Below 10mmHg (0.39inHg)

BEST IDLE ADJUSTMENT

1. Screw out all of the idle mixture adjusting screws 1½ turn from fully closed position.

— Note —

Screw in gently until fully closed, taking care not to injure the carburetor idle port or the screw tapered point.

2. Set to the maximum vacuum reading by turning each idle mixture adjusting screw.

— Caution —

Repeat adjustment 2 or 3 times to obtain maximum vacuum setting.

Best idle speed 1000 rpm

Manifold vacuum Above 330mmHg (13.00inHg)

3. Readjust the following 2 or 3 times.

- (1) Idle speed adjusting screw

Idle speed 1000 ± 50rpm

- (2) Synchronizing screw (Idle to 2000rpm)

Front and rear vacuum difference

Below 10mmHg (0.39inHg)

- (3) Idle mixture adjusting screw

Manifold vacuum

Above 330mmHg (13.00inHg)

Fig. 3-91

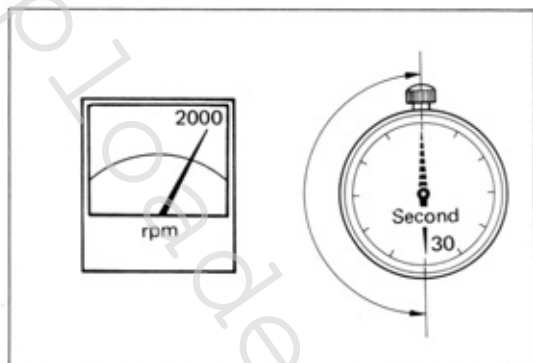


Fig. 3-92

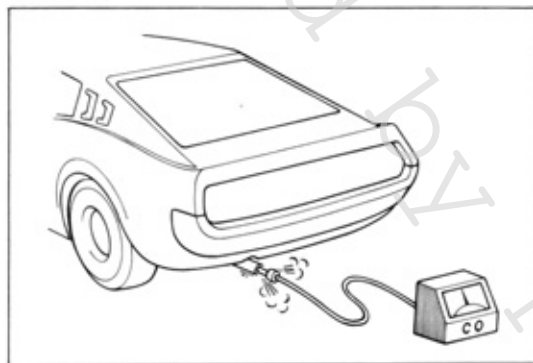


Fig. 3-93

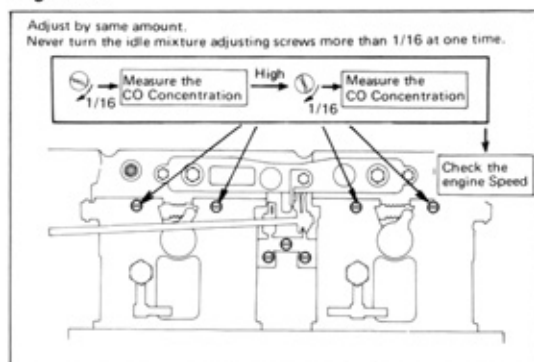
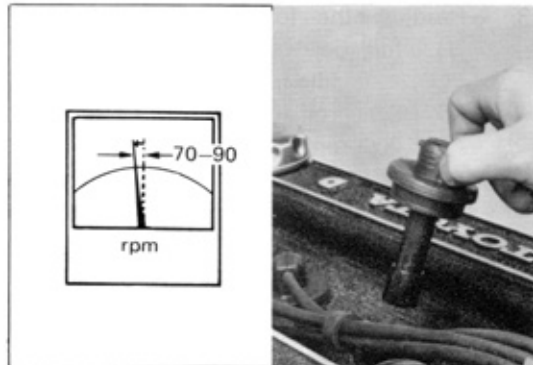


Fig. 3-94



CO CONCENTRATION



1. Measure the CO concentration
 - (1) Before measuring, race the engine at about 2,000 rpm for 30 – 60 seconds.



- (2) Measure within 1 to 3 minutes after racing the engine to allow the concentration to stabilize.

2. Adjust the CO concentration.
When the concentration is high:
 - (1) 4 idle mixture adjusting screws 1/16 turn.
 - (2) Measure the CO concentration again.
 - (3) If still high, 4 idle mixture adjusting screws another 1/16 turn.
 - (4) Check the engine speed.

— Note —

Do not allow rpm to be below best idle speed.



3. Check rpm of each cylinder when if misfires.

Decrease in rpm approx. 70 – 90 rpm
All four cylinders should show same decrease.

- (1) When one plug misfires, raise rpm and clean.
- (2) When decrease in rpm is not uniform, adjust with the idle mixture adjusting screw.

Fig. 3-95

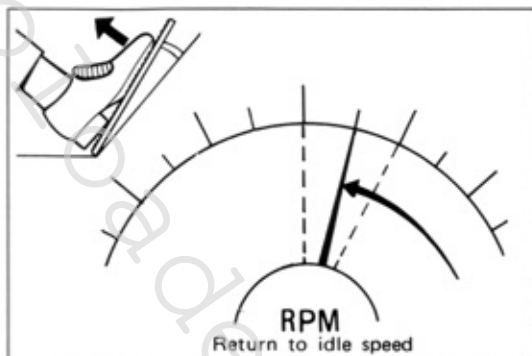


Fig. 3-96

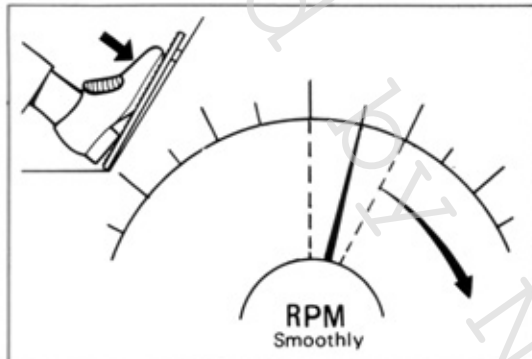
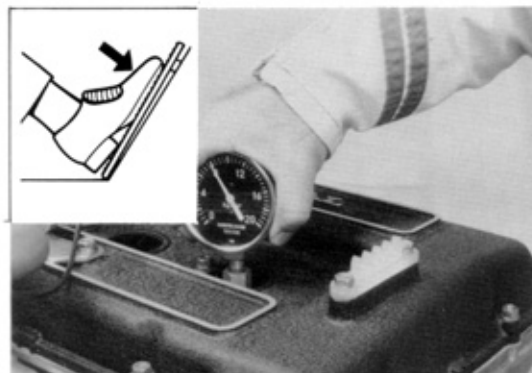


Fig. 3-97



Fig. 3-98



ENGINE CONDITION



1. Check if the engine returns to idle speed when both suddenly and slowly accelerated.



2. Opening throttle valve gradually should cause engine to speed up smoothly in relation to amount of valve opening.

COMPRESSION PRESSURE



1. Warm up the engine.
2. Remove all spark plugs.
3. Disconnect the high tension cord from ignition coil to cut-off the secondary circuit.



4. Insert a compression gauge into the spark plug hole, open the throttle valve fully, and measure the compression pressure while cranking the engine with starter motor.

Compression Pressure (at 200 rpm)

STD 13.0kg/cm² (184.6psi)

Limit 10.0kg/cm² (142.0psi)

Difference of pressure between cylinders Less than 1.0kg/cm² (14.2psi)

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18R ENGINE SERVICE

	Page
CUTAWAY VIEW	4-2
CYLINDER HEAD	
Includes: Cylinder Head, Valve and Spring Rocker Arm, Camshaft, Manifold	
DISASSEMBLY	4-4
INSPECTION & REPAIR	4-8
ASSEMBLY	4-17
TIMING GEAR	
Includes: Timing Gear, Chain, Damper and Slipper Pump Drive Shaft and Bearing, Front Oil Seal	
DISASSEMBLY	4-22
INSPECTION & REPAIR	4-24
ASSEMBLY	4-29
CYLINDER BLOCK	
Includes: Cylinder Block, Piston and Connecting Rod Piston Ring Crank pin and Bearing, Crankshaft and Bearing Flywheel, Rear Oil Seal Input Shaft Bearing	
DISASSEMBLY	4-34
INSPECTION & REPAIR	4-37
ASSEMBLY	4-47

CUTAWAY VIEW

Fig. 4-1

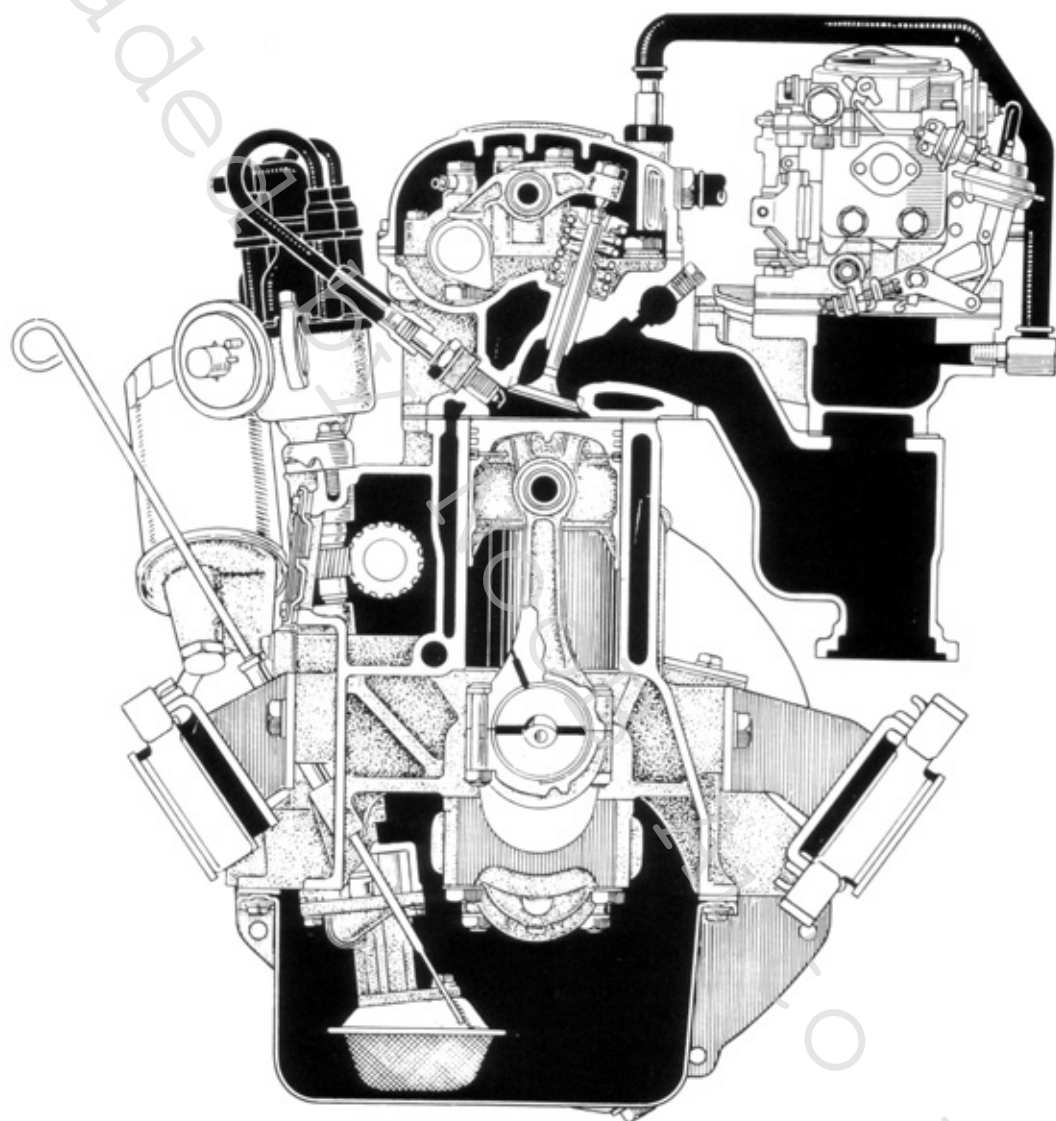
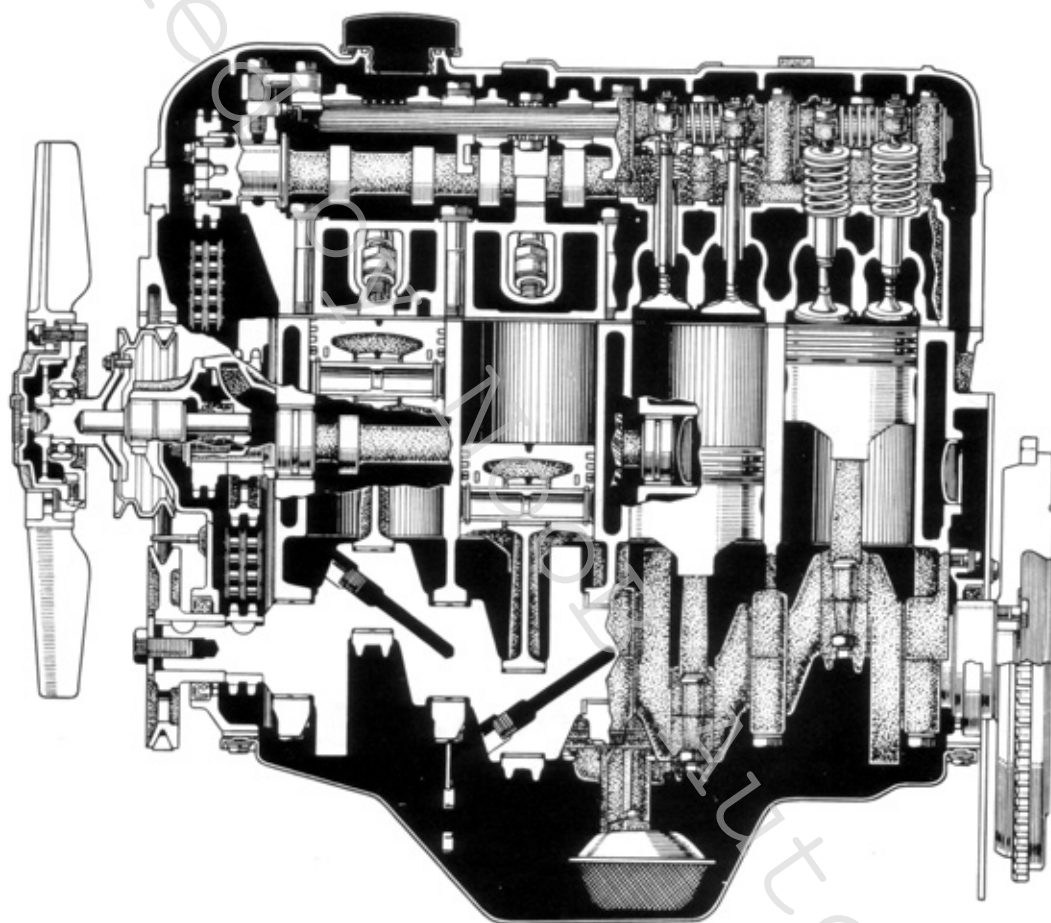


Fig. 4-2



CYLINDER HEAD DISASSEMBLY

Disassemble in numerical order.

Fig. 4-3

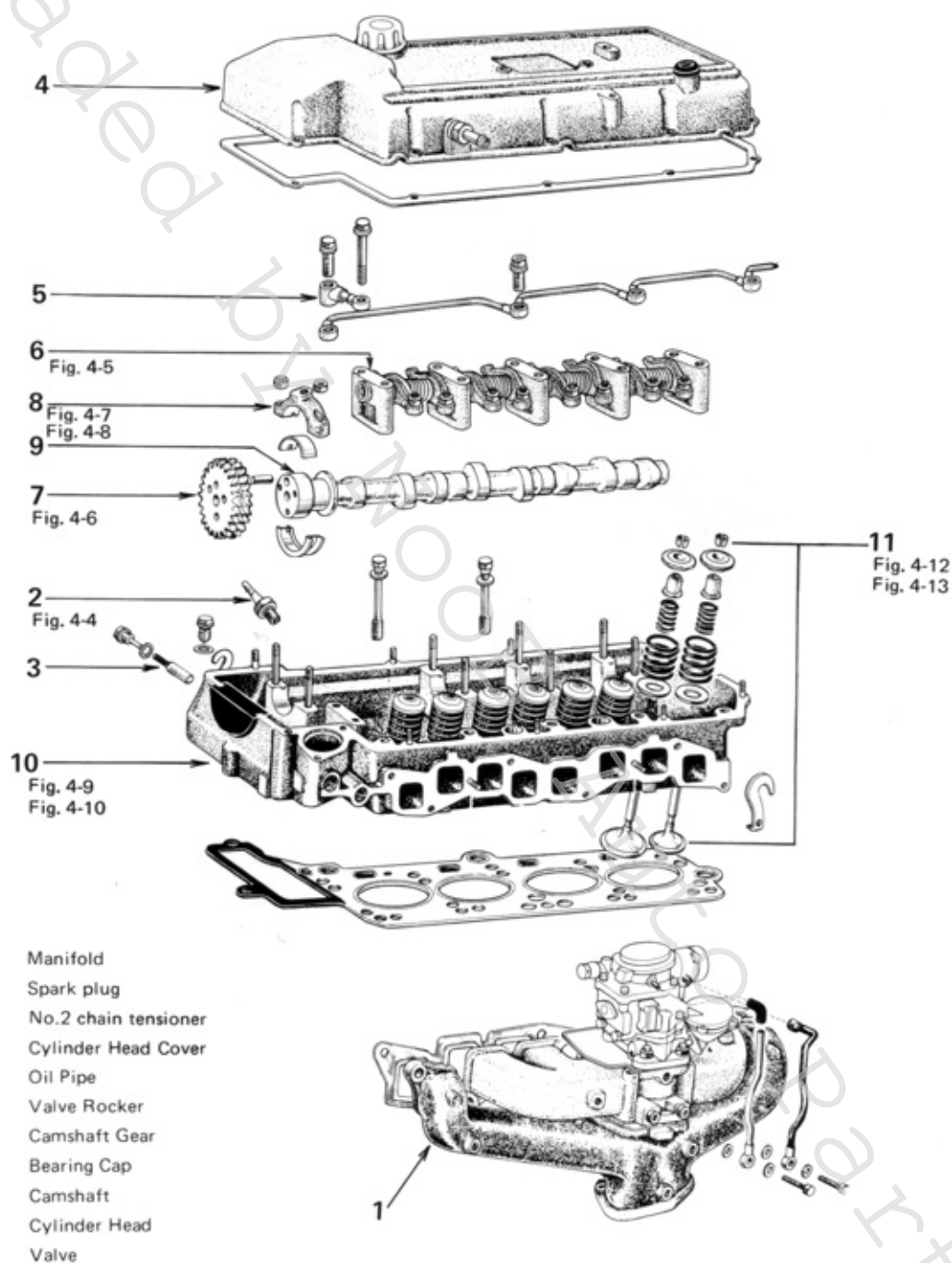
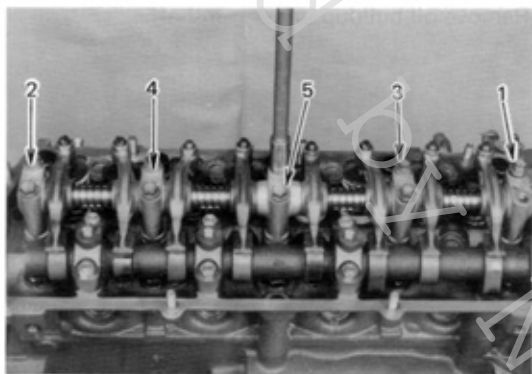


Fig. 4-4



Remove carefully plug cords by pulling rubber boot.

Fig. 4-5



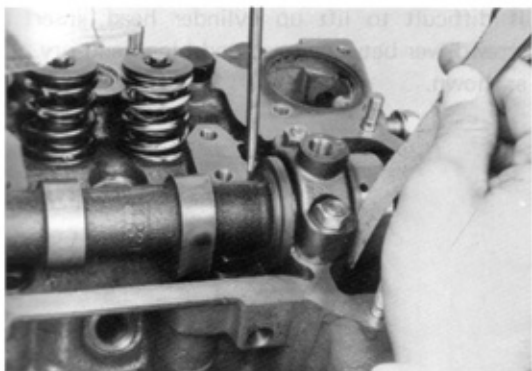
Gradually loosen rocker support bolts in 2 to 3 stages in the sequence as shown.

Fig. 4-6



Set No. 1 cylinder to TDC/compression.
Camshaft knock pin should point up.

Fig. 4-7



Measure camshaft thrust clearance.

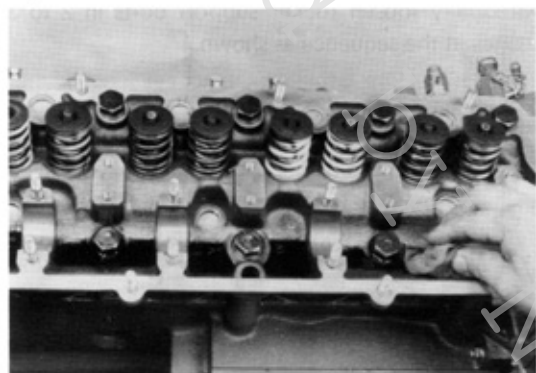
Thrust clearance limit 0.25 mm
(0.0098 in)

Fig. 4-8



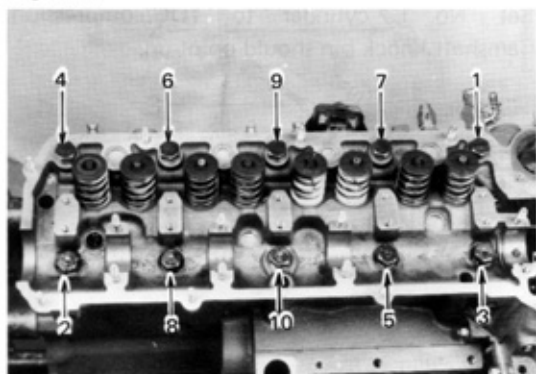
Keep camshaft bearing cap and bearing in order.

Fig. 4-9



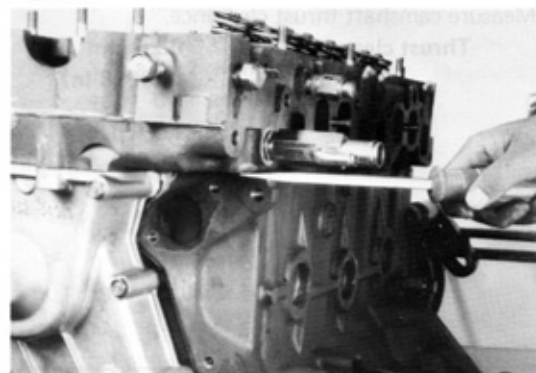
Remove oil buildup under camshaft.

Fig. 4-10



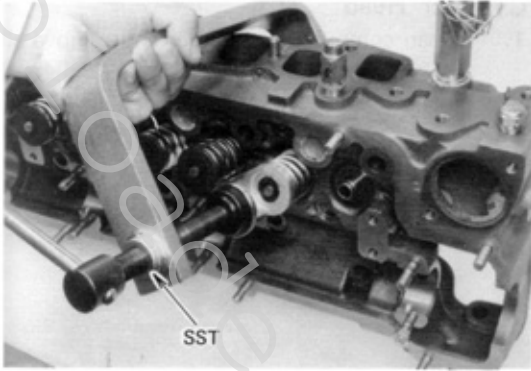
Gradually loosen cylinder head bolts in 2 to 3 stages in the sequence as shown.

Fig. 4-11



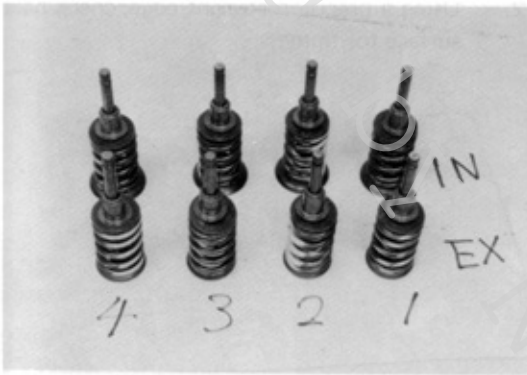
If difficult to lift up cylinder head, insert a screwdriver between head and block and pry off as shown.

Fig. 4-12



Compress the valve spring with SST [09202-43011].

Fig. 4-13



Keep valve and oil seal in order.

Fig. 4-15



Fig. 4-16

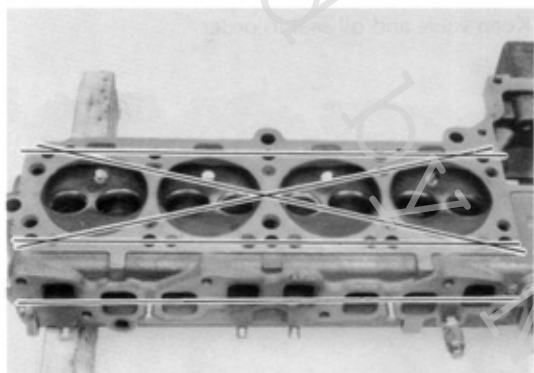


Fig. 4-17

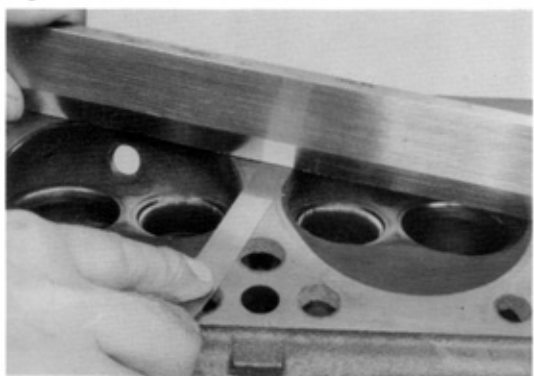
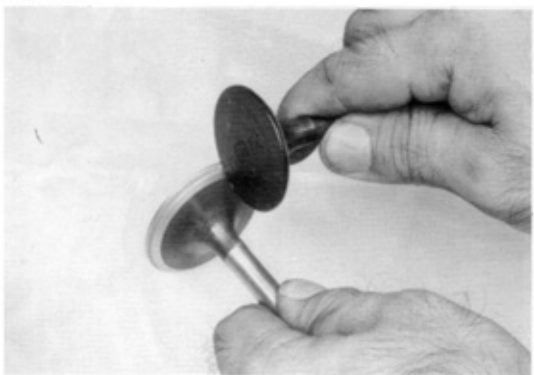


Fig. 4-18



INSPECTION & REPAIR

Cylinder Head



1. Clean combustion chamber and remove all gasket material from manifold and head surface.



2. Using a precision straight edge, check head surface for flatness.



3. If warpage exceeds limit,, correct by machining or replace head.

Head surface warpage limit

0.05 mm (0.0019 in)

Maximum reface limit

0.2 mm (0.0079 in)



Valve, Guide and Seat

1. Clean valves.

Fig. 4-19

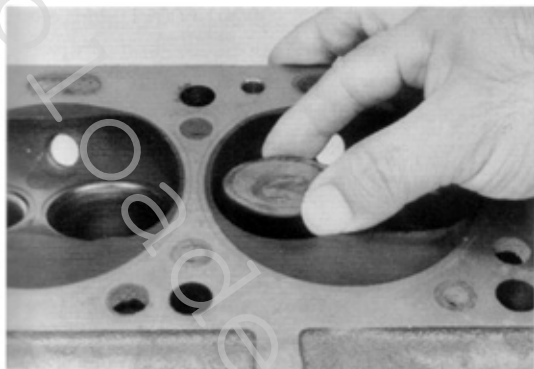


Fig. 4-20



Fig. 4-21

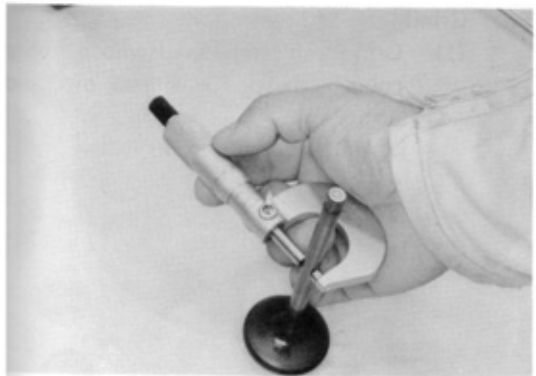
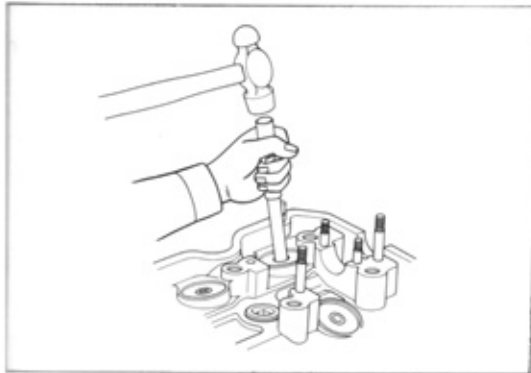


Fig. 4-22



2. Quick-check valve stem and guide wear by inserting correct valve in guide and moving valve as shown.



3. Measure valve stem oil clearance
 - (1) Measure inside diameter of valve guide.



- (2) Measure valve stem diameter.
- (3) Subtract stem measurement.

Clearance limit

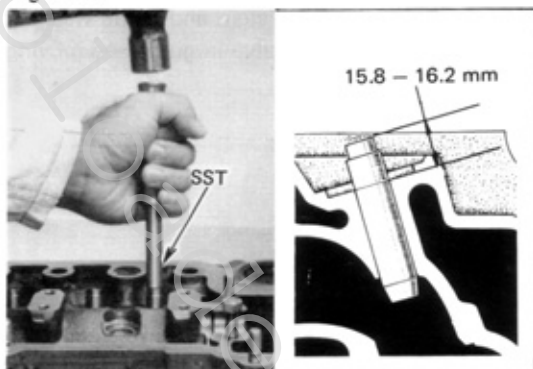
Intake	0.08 mm	0.0032 in
Exhaust	0.10 mm	0.0039 in

Replace guide and valve if clearance exceeds limit.



4. Replace guide
 - (1) Drive out guide from the top end toward the combustion chamber, use SST [09201-60011].

Fig. 4-23

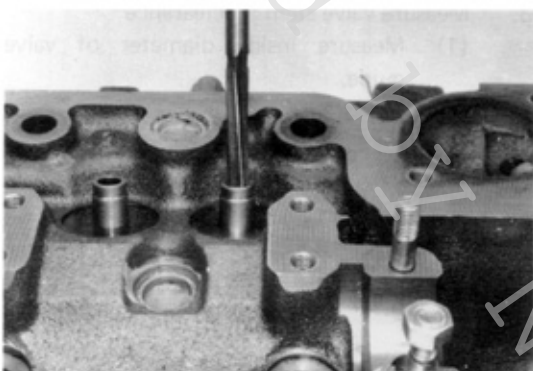


- (2) Using SST [09201-60011], drive in new guide until its end projects from cylinder head the distance noted below.

Projection distance

15.8–16.2 mm
(0.622–0.638 in)

Fig. 4-24

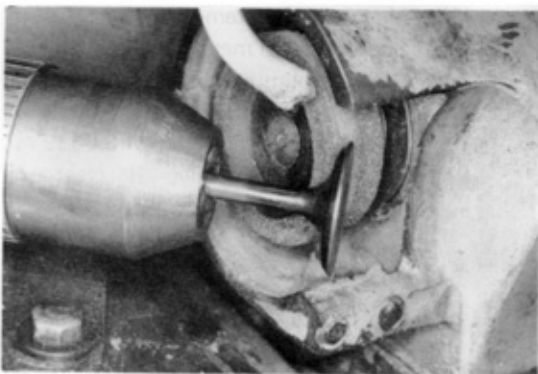


- (3) Using a sharp 8 mm reamer, ream guide to obtain specified clearance.

Intake 0.03–0.06 mm
(0.0012–0.0024 in)

Exhaust 0.04–0.08 mm
(0.0016–0.0032 in)

Fig. 4-25

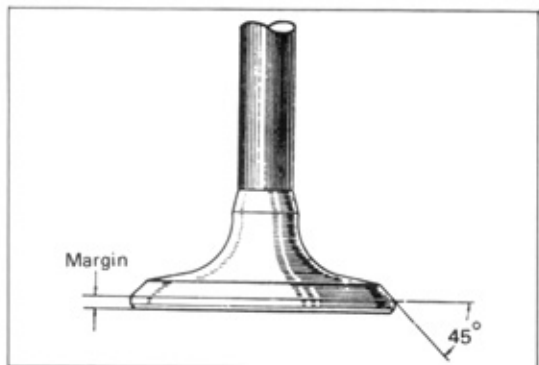


5. Grind valve and seat

- (1) Grind all valves. Remove only enough metal to remove pits and carbon.

Valve face angle : 45°

Fig. 4-26



- (2) Check margin.

If valve head margin is less than specification, replace valve.

Margin limit

Intake 0.6 mm (0.024 in)

Exhaust 0.6 mm (0.024 in)

Fig. 4-27

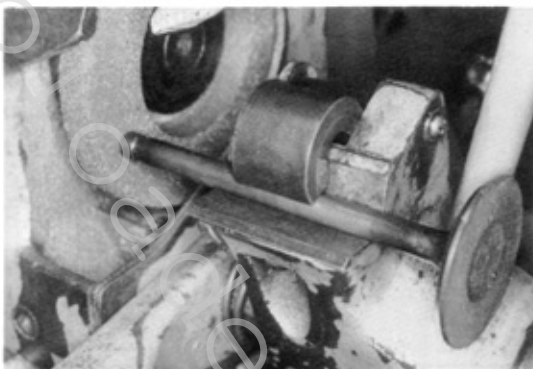


Fig. 4-28

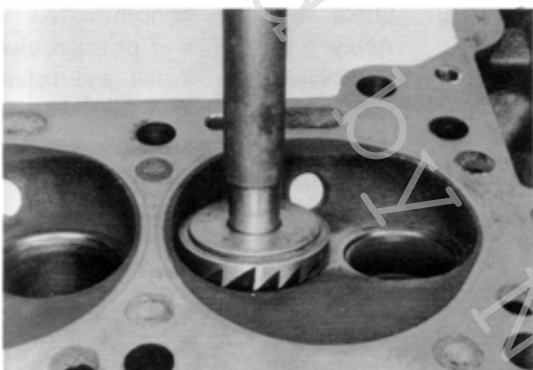


Fig. 4-29

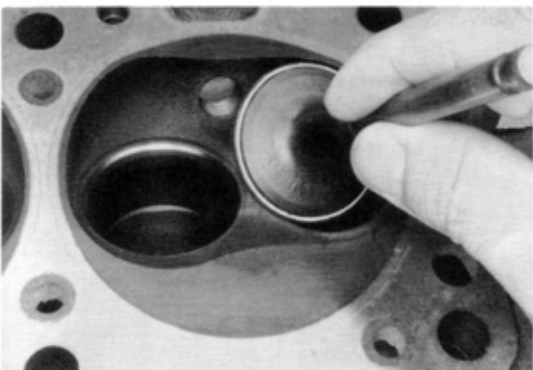
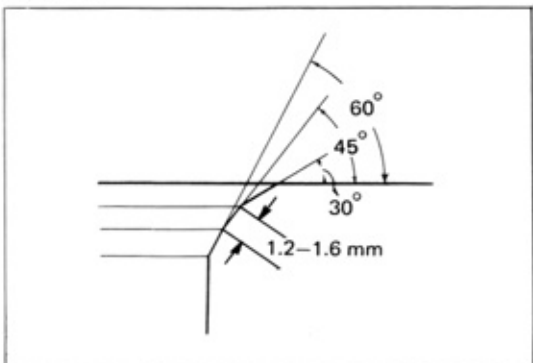


Fig. 4-30



- (3) If valve stem tip has been worn by rocker arm, resurface with valve grinder.

Do not grind more than 0.5 mm (0.02 in).

Overall length limit 112.7 mm (4.437 in)

- (4) Resurface valve seats with 45° carbide cutter.
Remove only enough metal to clean seat.

- (5) Coat valve face with prussian blue or white lead. Locate contact point on valve by rotating valve against seat.

— Note —

Seat contact should be in middle of valve face with following width:

Intake 1.2–1.6 mm (0.047–0.063 in)

Exhaust 1.2–1.6 mm (0.047–0.063 in)

- (6) Correct seat position.
To correct seating that is too high, use 30° and 45° cutters. If seating is too low, use 65° and 45° cutters.

Fig. 4-31

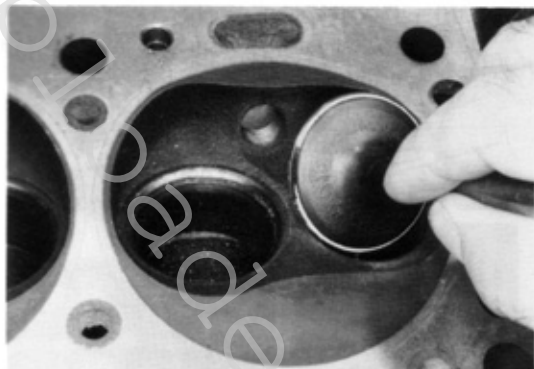


Fig. 4-32

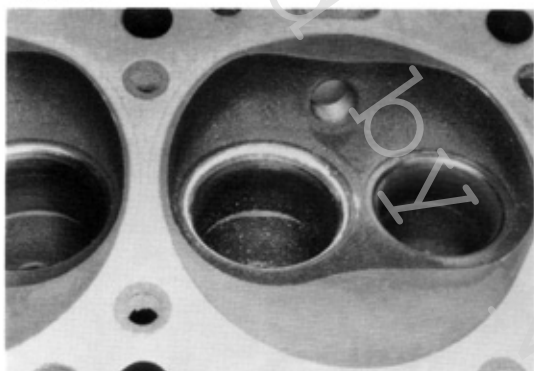


Fig. 4-33

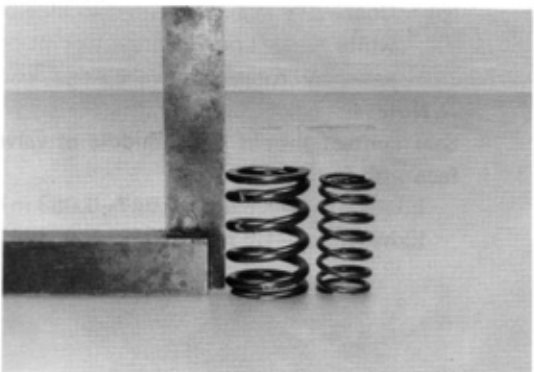
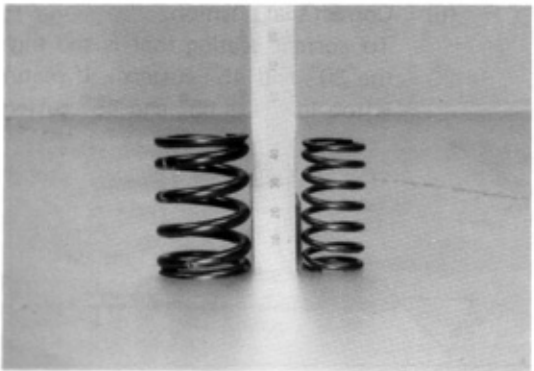


Fig. 4-34



- (7) Check valve concentricity. Lightly coat seat with prussian blue. Install valve and rotate. If blue appears 360° around face, valve stem and face are concentric. If not, replace valve.

- (8) Check seat/guide concentricity. Apply a light coat of prussian blue on valve face. Install and rotate valve. If blue appears 360° around valve seat, guide and seat are concentric. If not, recut seat.



Valve Spring

1. Check squareness of valve springs with steel square. If spring is out of square more than limit, replace.

Limit

Inner	1.6 mm (0.063 in)
Outer	1.9 mm (0.075 in)

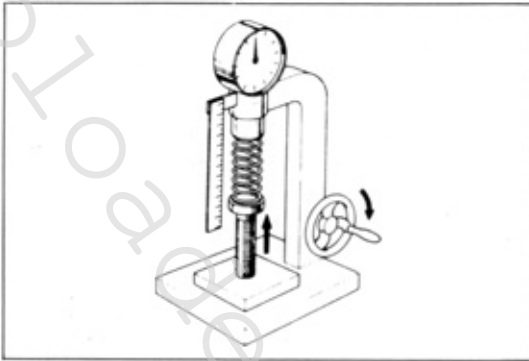


2. Measure free height of all springs. Replace any spring that is out of specification.

Free height

Inner	44.1 mm (1.736 in)
Outer	46.5 mm (1.830 in)

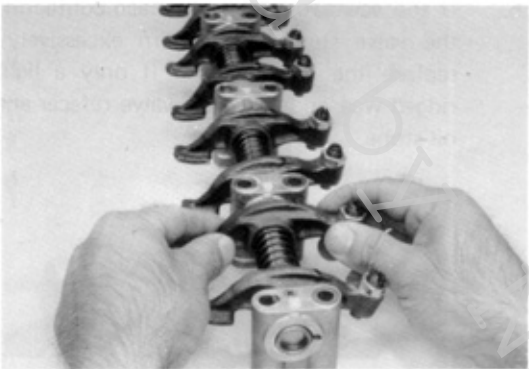
Fig. 4-35



3. Using a spring tester, measure tension of each spring at the specified installed height. Replace any spring that does not meet specification.

	Inner	Outer
Limit	6.0 kg (13.23 lb)	19.0 kg (41.89 lb)
Standard	6.9 kg (15.21 lb)	23.0 kg (50.71 lb)

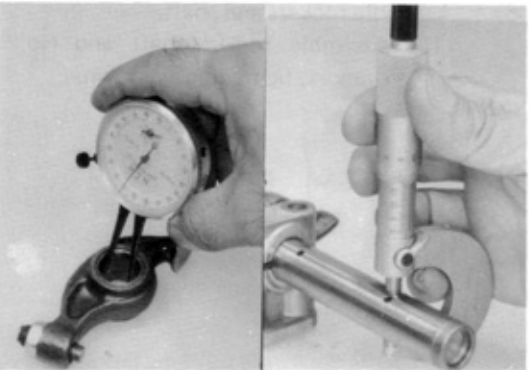
Fig. 4-36



Rocker Arm and Shaft

1. Check rocker arm to shaft clearance by moving rocker arm as shown. Little or no movement should be indicated. If movement is felt, disassemble and inspect.

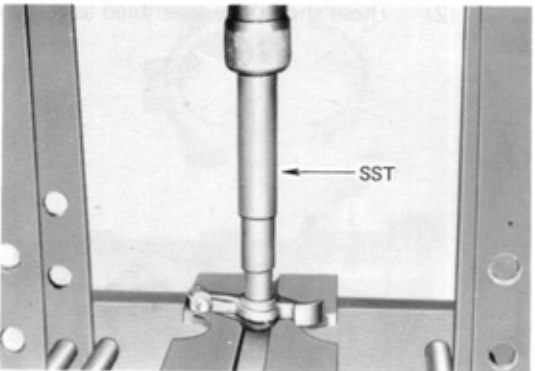
Fig. 4-37



2. If movement was felt above, measure rocker oil clearance with dial indicator and outside micrometer. If clearance is excessive, replace rocker arm bushings and/or shaft.

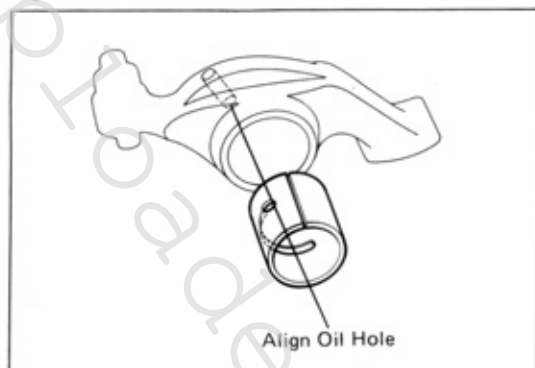
Clearance Limit	0.08 mm (0.0032 in)
Standard	0.02–0.05 mm (0.0008–0.0020 in)

Fig. 4-38



3. To remove the rocker arm bushing, use SST [09222-30010].

Fig. 4-39



4. When assembling bushing, align oil hole with that of the rocker arm. After assembling, ream bushing to obtain specified oil clearance.

Standard **0.02—0.05 mm**
(0.0008—0.0020 in)

Fig. 4-40



5. If the valve rocker arm surface contacting the valve stem end is worn excessively, replace the rocker arm. If only a light ridged wear, correct with valve refacer and oil stone.

Fig. 4-41

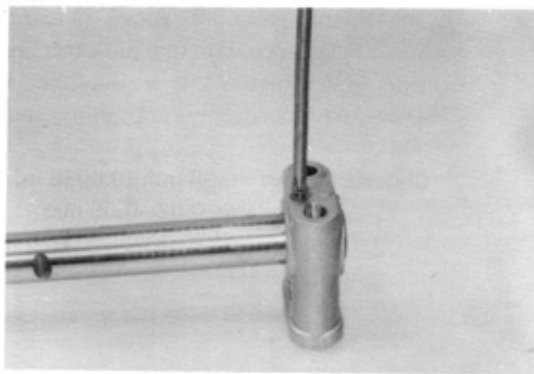
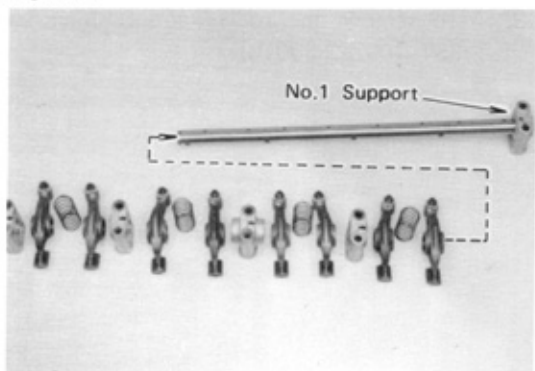


Fig. 4-42



6. Assemble rockers and shaft.

(1) Assemble rocker shaft and No. 1 support, tightening as shown.



(2) These should be assembled as shown.

Fig. 4-43

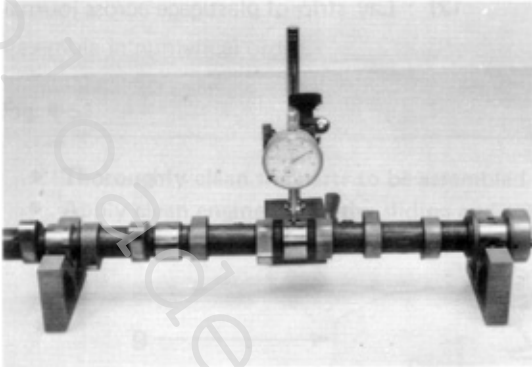


Fig. 4-44

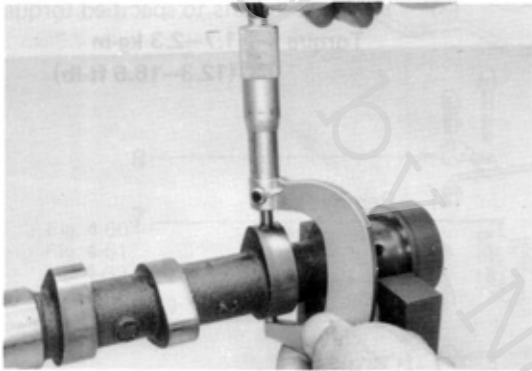


Fig. 4-45

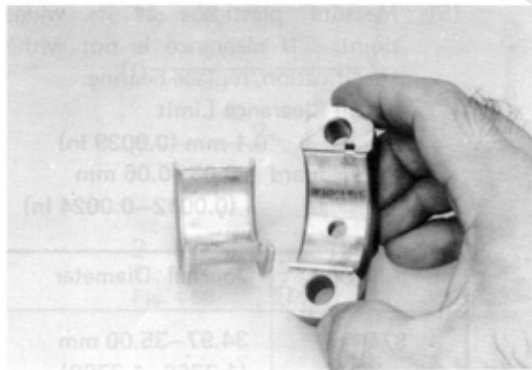
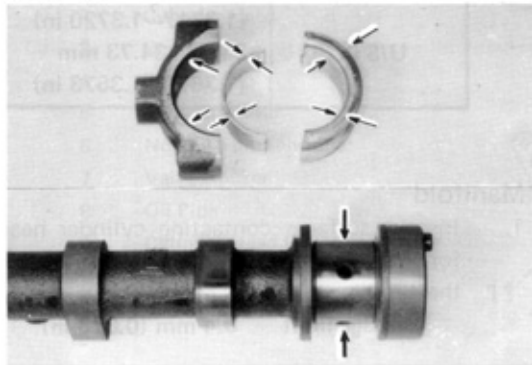


Fig. 4-46

**Camshaft and Bearing**

1. Check camshaft for runout and if it exceeds limit replace.

Runout limit **0.1 mm 0.004 in**



2. Measure cam lobe height. If wear exceeds limit, replace camshaft.

Height limit Intake **43.7 mm (1.720 in)**

Exhaust **43.8 mm (1.724 in)**

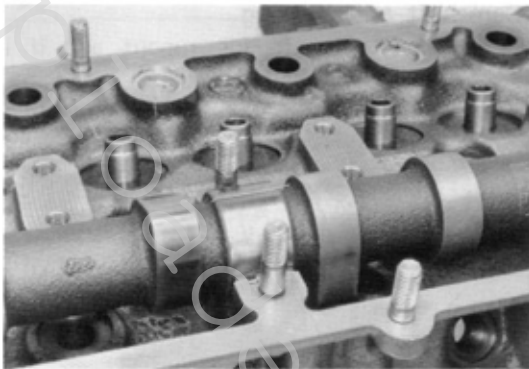


3. Check bearings for flaking or scoring. If bearings are damaged, replace.



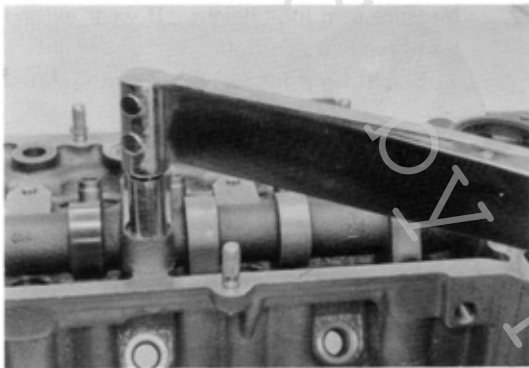
4. Measure camshaft oil clearance.
(1) Clean bearing, cap and camshaft journal.

Fig. 4-47



- (2) Lay strip of plastigage across journal.

Fig. 4-48

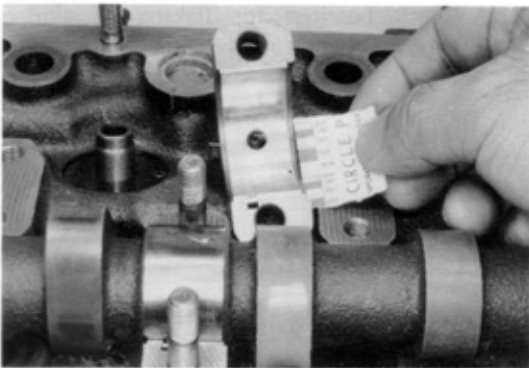


- (3) Tighten cap nuts to specified torque.

Torque 1.7–2.3 kg-m
(12.3–16.6 ft-lb)

- (4) Remove cap.

Fig. 4-49



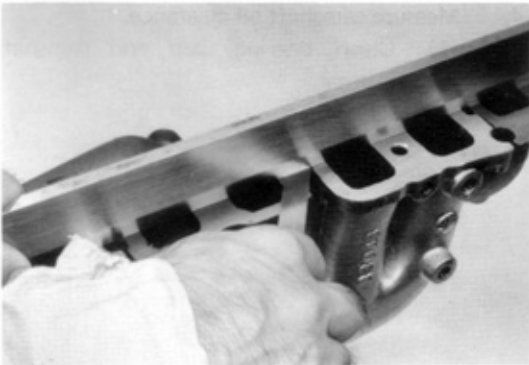
- (5) Measure plastigage at its widest point. If clearance is not within specification, replace bearing.

Oil Clearance Limit

0.1 mm (0.0039 in)

Standard 0.03–0.06 mm
(0.0012–0.0024 in)

Fig. 4-50



Bearing Size	Journal Diameter
STD	34.97–35.00 mm (1.3768–1.3780)
U/S 0.125	34.84–34.85 mm (1.3717–1.3720 in)
U/S 0.25	34.72–34.73 mm (1.3670–1.3673 in)

Manifold

1. Inspect surfaces contacting cylinder head for warpage, and replace if warped over the limit.

Warpage limit 0.4 mm (0.016 in)

ASSEMBLY

Assemble in numerical order.

Fig. 4-51

- Thoroughly clean the parts to be assembled.
- Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.

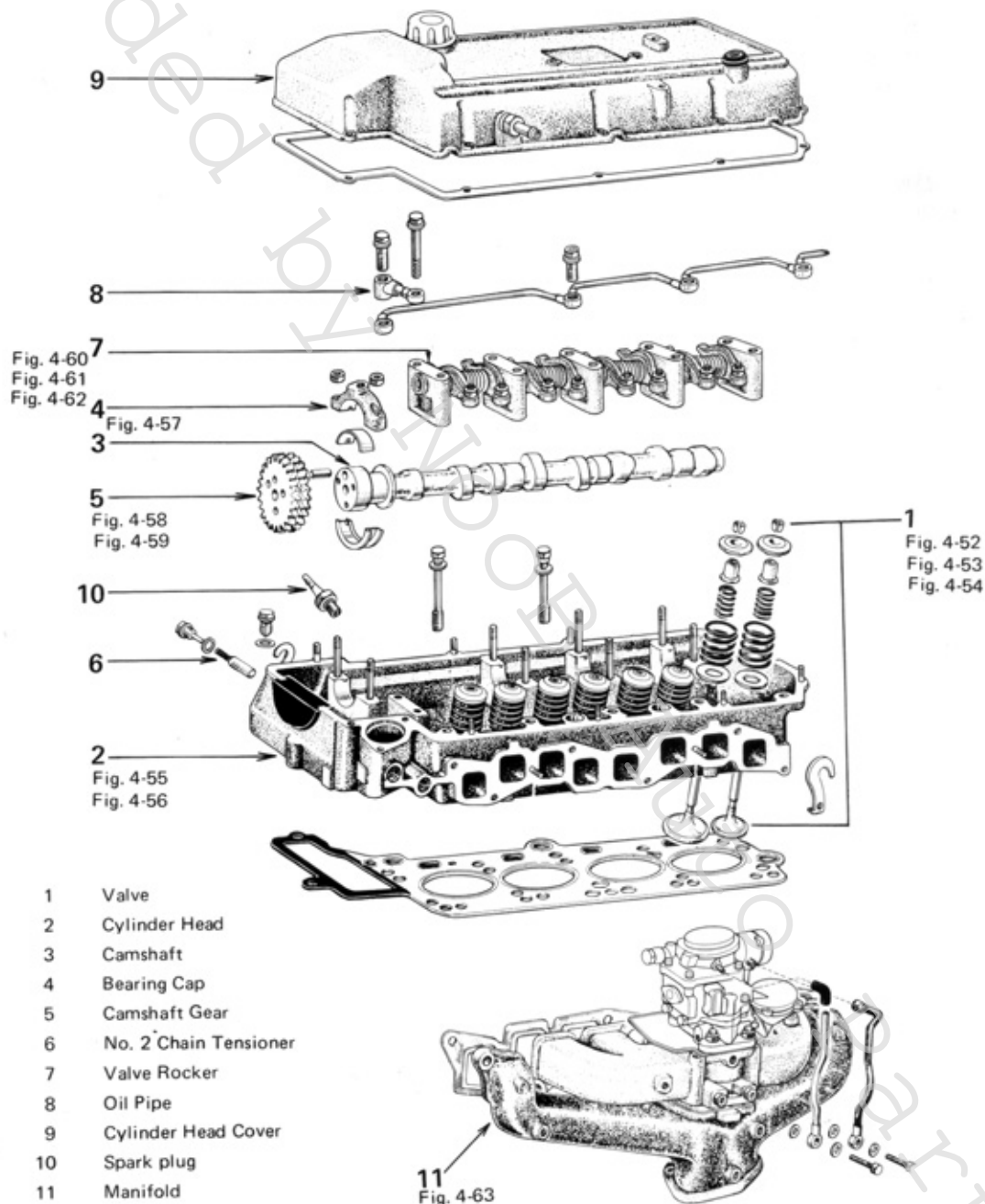
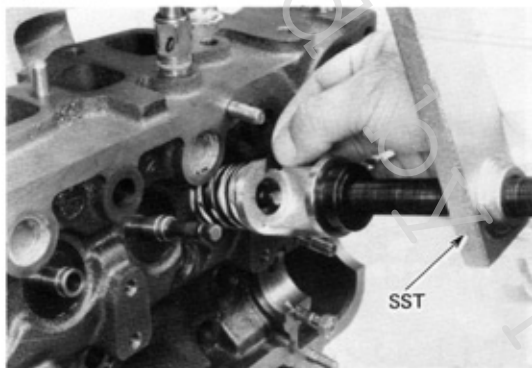


Fig. 4-52



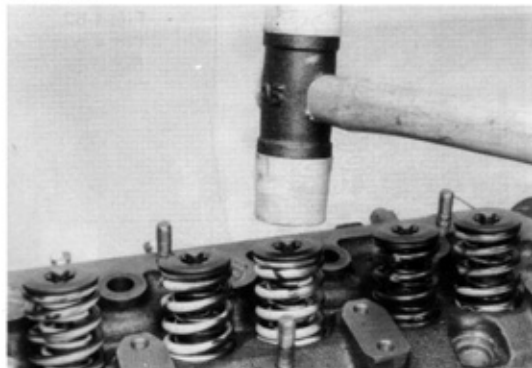
Assemble spring seat and oil seal as shown. The oil seal should be inserted until its end contacts spring seat top.

Fig. 4-53



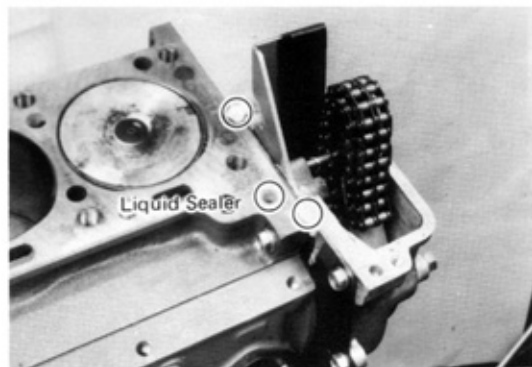
Compress the valve spring with SST [09202-43011] and install retainer locks.

Fig. 4-54



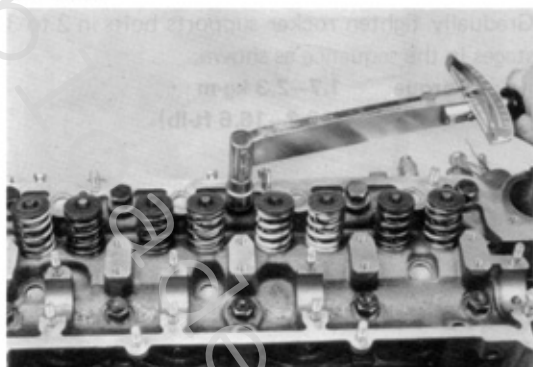
After assembling valve spring, tap stem lightly to assure proper fit.

Fig. 4-55



Apply liquid sealer on the cylinder head, around the oil holes in the block, and in the vicinity of the timing chain cover and cylinder block.

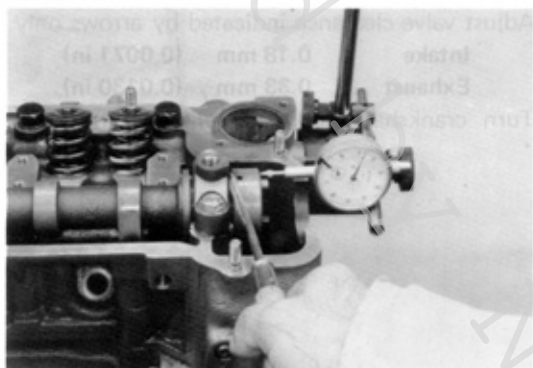
Fig. 4-56



Gradually tighten cylinder head bolts in 2 to 3 stages in the sequence as shown.

Torque 10–12 kg-m (72.3–86.8 ft-lb)

Fig. 4-57

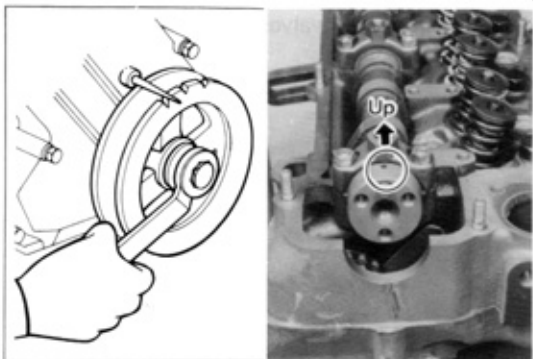


Make sure of camshaft thrust clearance.

Thrust Clearance Standard

0.15–0.30 mm (0.0059–0.0118 in)

Fig. 4-58



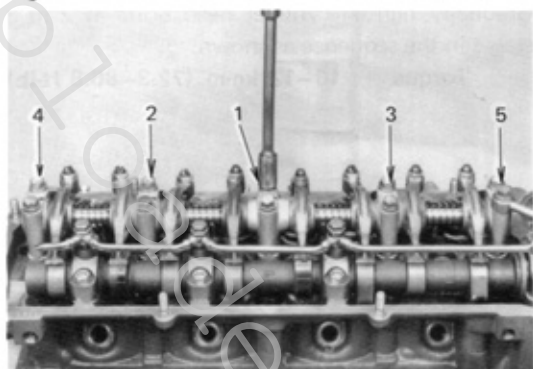
Set to No. 1 cylinder TDC/compression.
Camshaft knock pin should point up.

Fig. 4-59



Align chain and gear with marking made.
Install the No. 2 chain with it mark aligned with the gear mark.
Align gear pin hole and camshaft knock pin and install them.

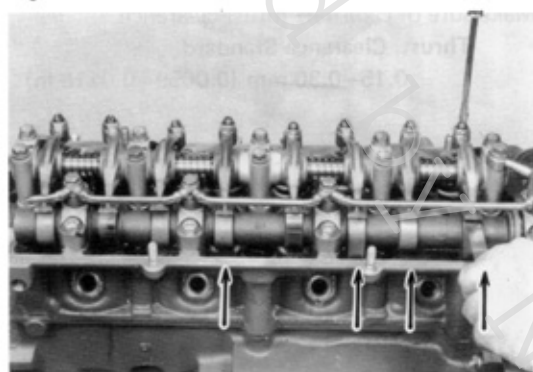
Fig. 4-60



Gradually tighten rocker supports bolts in 2 to 3 stages in the sequence as shown.

Torque 1.7–2.3 kg-m
(12.3–16.6 ft-lb)

Fig. 4-61



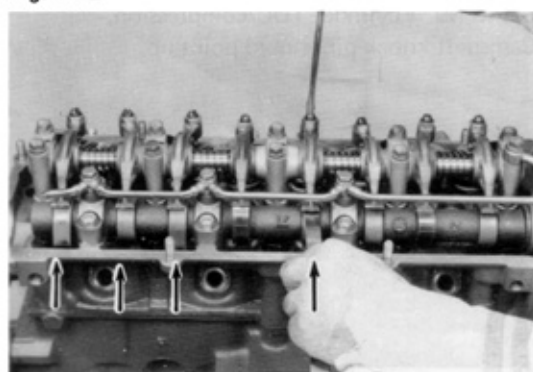
Adjust valve clearance indicated by arrows only.

Intake 0.18 mm (0.0071 in)

Exhaust 0.33 mm (0.0130 in)

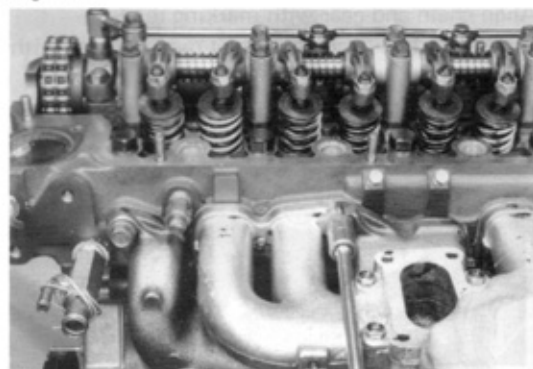
Turn crankshaft 360° and align timing mark.

Fig. 4-62



Adjust remaining valves indicated by arrows.

Fig. 4-63



Tighten the manifold securing nuts in the sequence as shown.

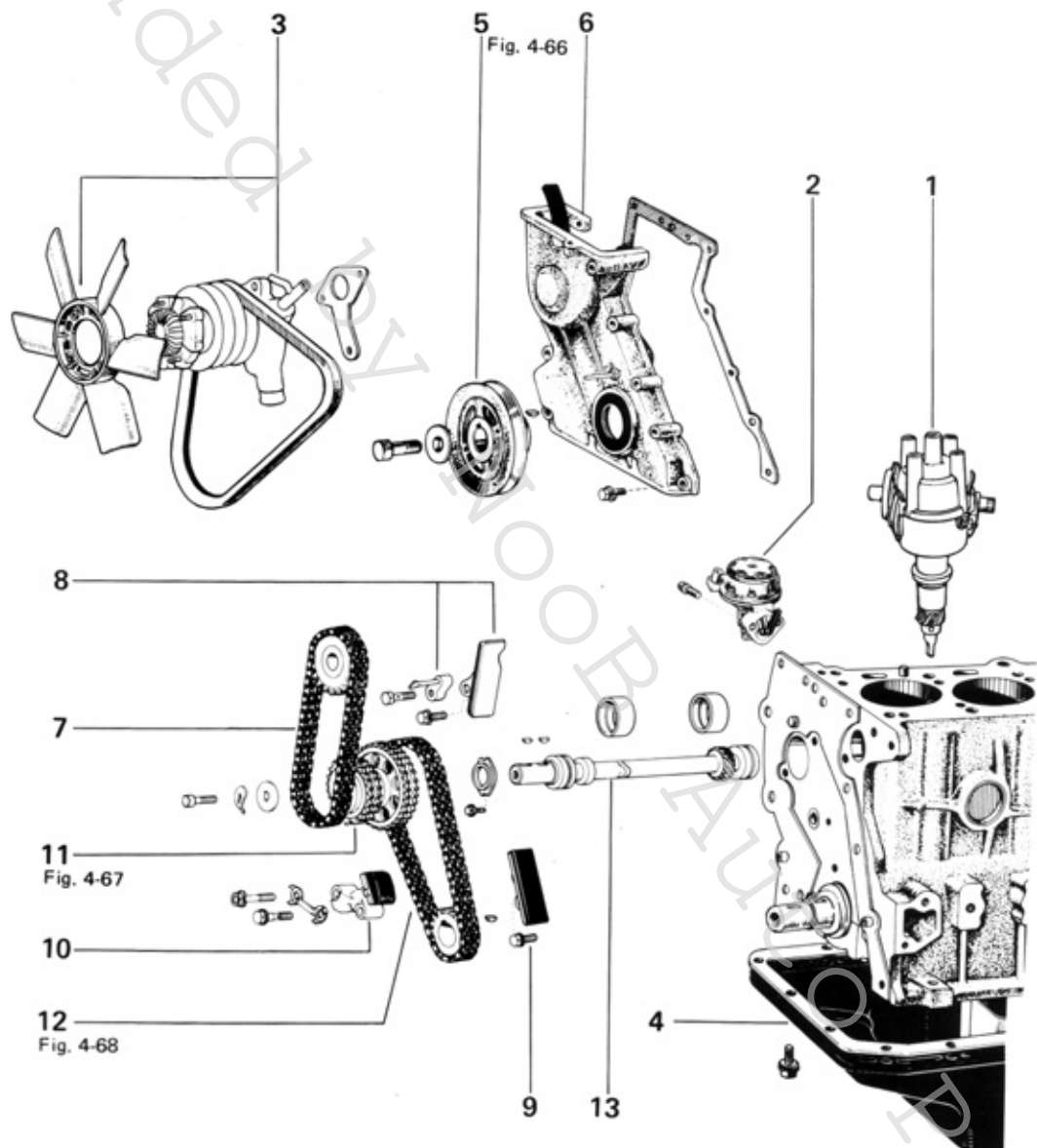
Torque 4.5–5.5 kg-m
(32.6–39.8 ft-lb)

Uploaded by Noob Auto Parts

TIMING CHAIN DISASSEMBLY

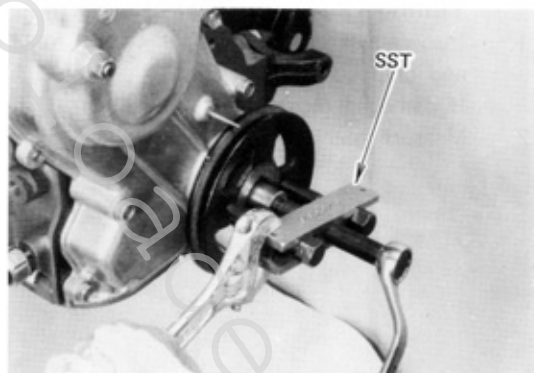
Disassemble in numerical order.

Fig. 4-65



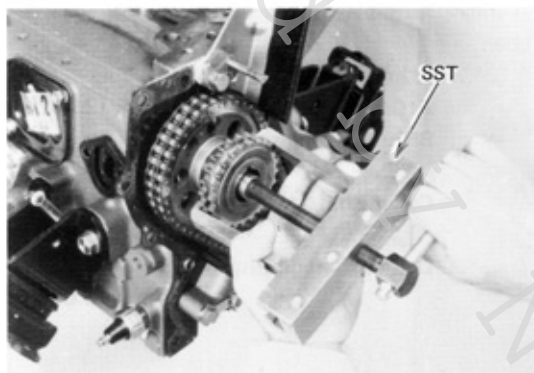
- | | | | | | |
|---|--------------------|---|--------------------|----|-----------------------------|
| 1 | Distributor | 5 | Crankshaft Pulley | 9 | No. 1 Chain Damper |
| 2 | Fuel Pump | 6 | Timing Gear Cover | 10 | No. 1 Chain Tensioner |
| 3 | Fan and Water Pump | 7 | No. 2 Timing Chain | 11 | Camshaft Drive Gear |
| 4 | Oil Pan | 8 | No. 2 Chain Damper | 12 | No. 1 Timing Chain and Gear |
| | | | and Oil Jet | 13 | Pump Drive Shaft |

Fig. 4-66



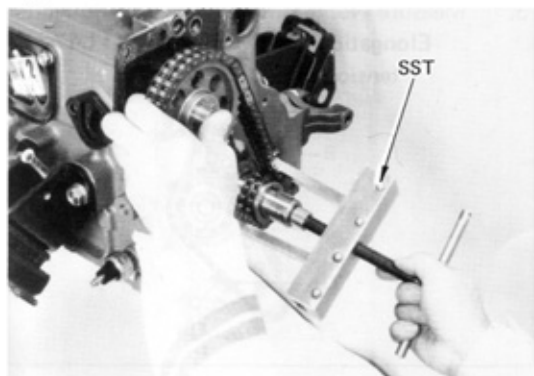
Pull out crankshaft pulley.
Use SST [09213-31021].

Fig. 4-67



Pull out camshaft drive gear.
Use SST [09213-36010].

Fig. 4-68



When removing these gears, hook the SST [09213-36010] alternately on the two gears and pull them out uniformly.

Fig. 4-70

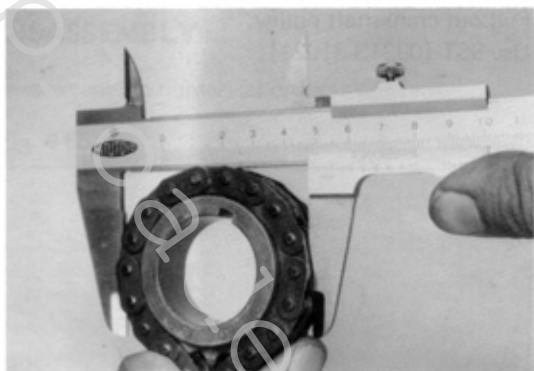


Fig. 4-71

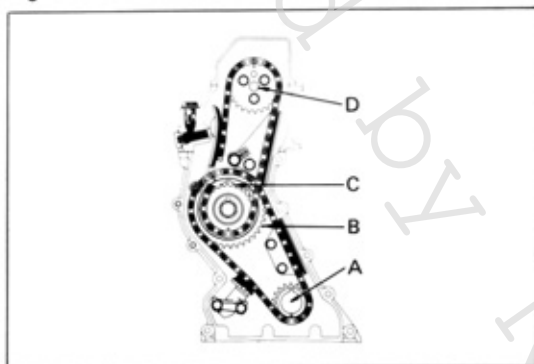


Fig. 4-72

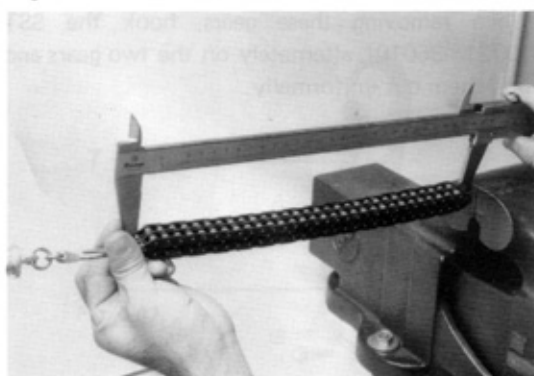
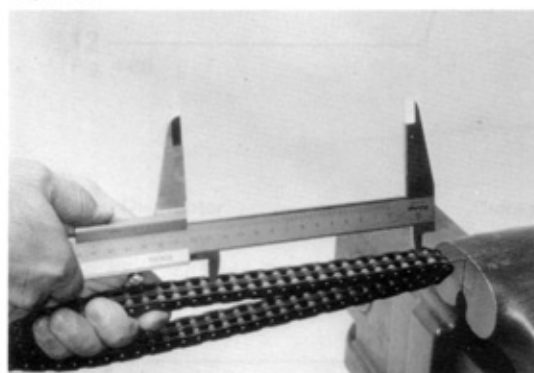


Fig. 4-73



INSPECTION AND REPAIR

Timing Gear and Chain



1. Inspect gear and chain for cracks, wear, and chipped teeth.
If damaged replace gears and chain.
2. Measure gear for wear as shown.



If measurement is below limit, replace gears and chain.

Wear limit

A: Crank shaft gear 60.0 mm (2.362 in)

B: Pump drive shaft gear
114.5 mm (4.508 in)

C: Camshaft drive gear
78.2 mm (3.079 in)

D: Camshaft timing gear
78.2 mm (3.079 in)



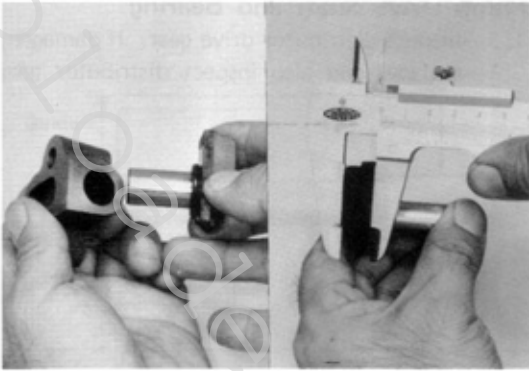
3. Measure No. 1 timing chain for elongation.
Elongation limit 291.4 mm (11.47 in)
tension at 5kg (11 lb)



4. Measure No. 2 timing chain for elongation. Measure the length of 17 links with the chain stretched tight with the force of one hand. Make the same measurements at more than three other places selected at random.
If over the limit at any one place, replace the chain.

Elongation limit (at 17 links)
147 mm (5.787 in)

Fig. 4-74

**No. 1 Chain Tensioner**

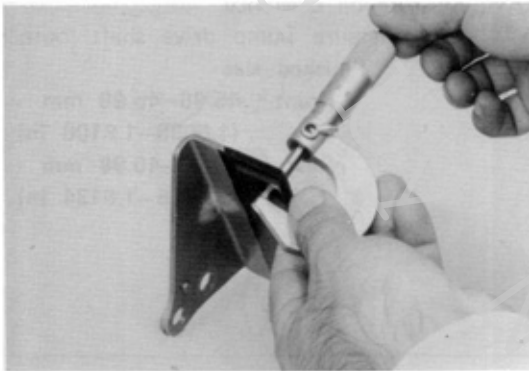
Inspect body and plunger for wear.

Measure tensioner head as shown.

If worn below limit, replace unit.

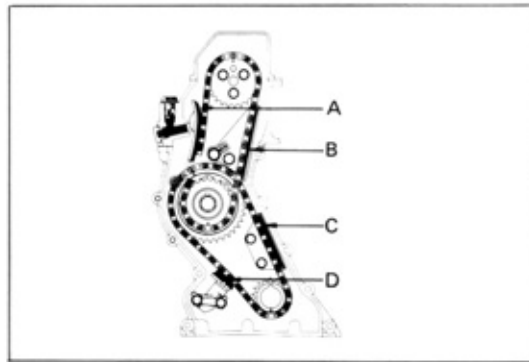
**Wear limit 11.5 mm (0.453 in)**

Fig. 4-75

**Chain Damper and Slipper**

Inspect chain dampers for wear. Measure each damper.

Fig. 4-76



If either is visibly worn or measures less than limit, replace unit

Wear limit**A: Slipper**

6.8 mm (0.26 in)

B: No. 2 damper

5.0 mm (0.20 in)

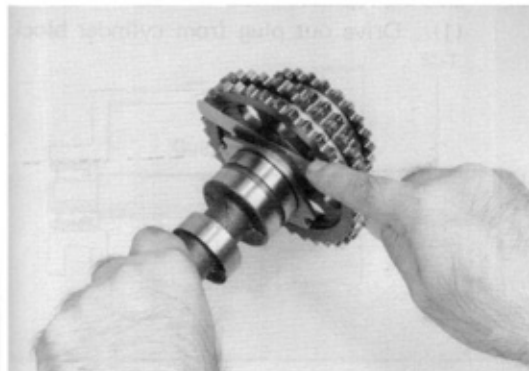
C: No. 1 damper

5.0 mm (0.20 in)

D: No. 1 tensioner

11.5 mm (0.45 in)

Fig. 4-77

**Timing Gear and Thrust Plate**

Measure thrust clearance.

If it exceeds limit, replace thrust plate.

Thrust clearance**limit 0.3 mm (0.012 in)****Standard**

0.06–0.13 mm (0.0024–0.0051 in)

Fig. 4-78

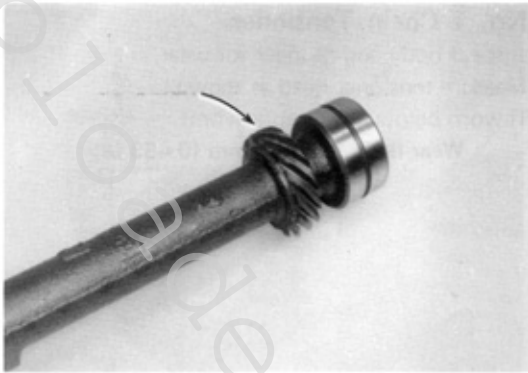


Fig. 4-79

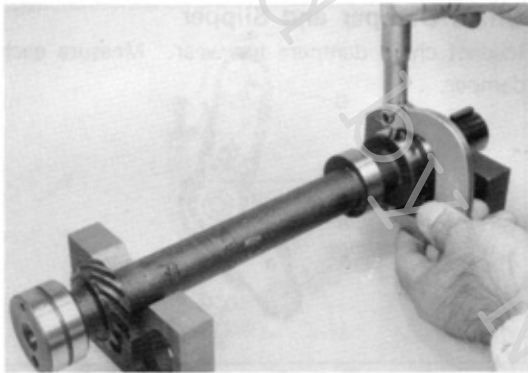


Fig. 4-80

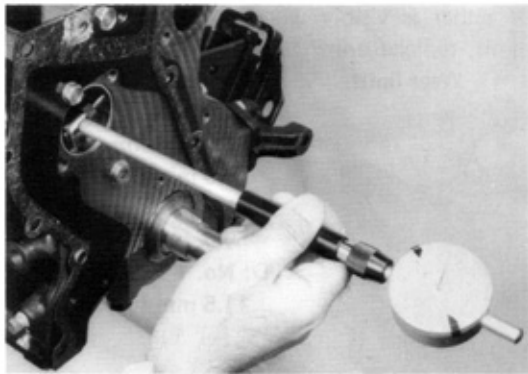
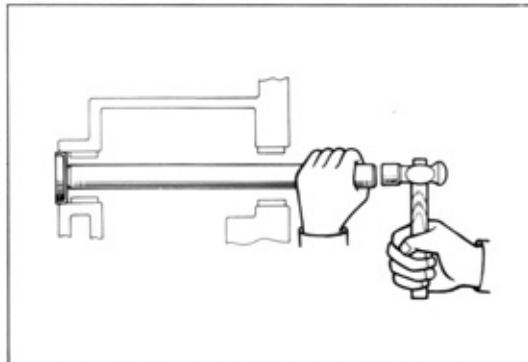


Fig. 4-81

**Pump Drive Shaft and Bearing**

1. Inspect distributor drive gear. If damaged, replace, and also inspect distributor gear.



2. Measure oil clearance
 - (1) Measure pump drive shaft journal.

Finished size

Front	45.96–45.98 mm (1.8098–1.8106 in)
Rear	40.96–40.98 mm (1.6126–1.6134 in)



- (2) Measure inner diameter of bearing.

Oil clearance limit

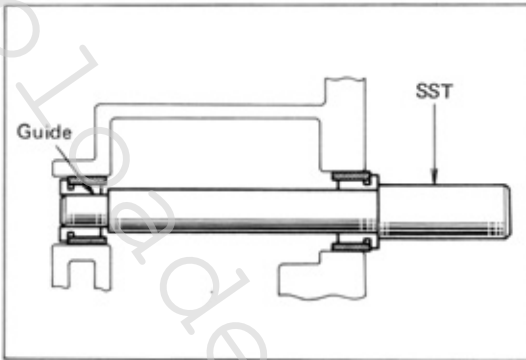
0.08 mm (0.0032 in)

Standard0.03–0.07 mm
(0.0008–0.0024 in)

3. Bearing replacement

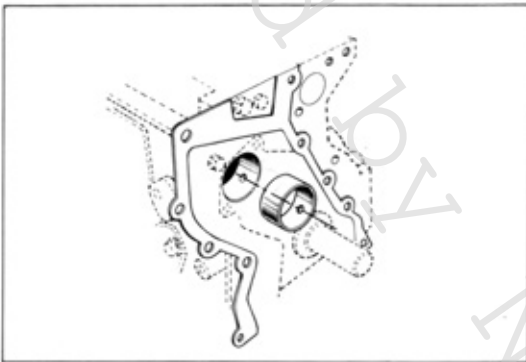
- (1) Drive out plug from cylinder block.

Fig. 4-82



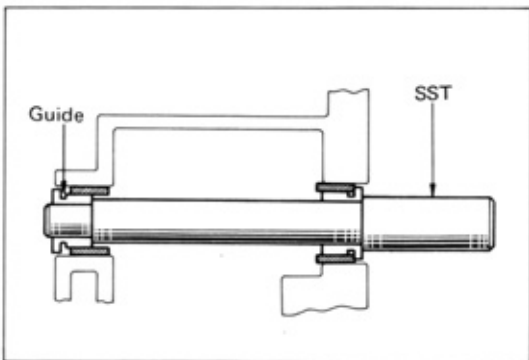
- (2) Remove front bearing.
Use SST [09233-33010] as shown.

Fig. 4-83



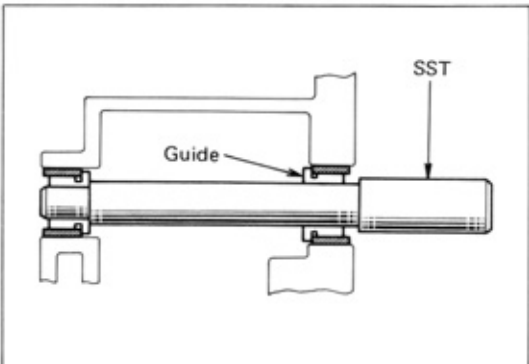
- (3) Align bearing oil hole.

Fig. 4-84



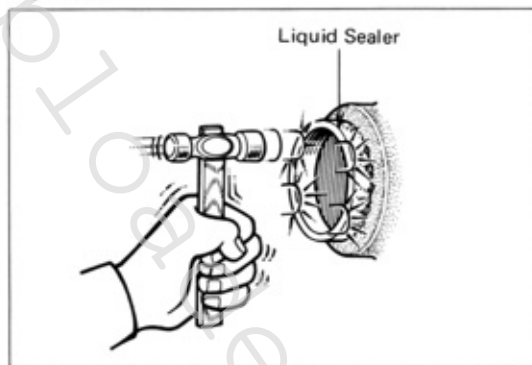
- (4) Install front bearing.
Use SST [09233-33010] as shown.
Bearing fitting tolerance
0.02–0.06 mm
(0.0008–0.0024 in)

Fig. 4-85



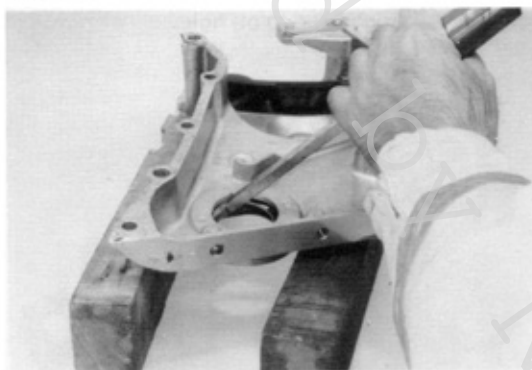
- (5) Remove rear bearing.
Replacement for rear bearing as same as front bearing.

Fig. 4-86



- (6) Install new plug applied with liquid sealer.

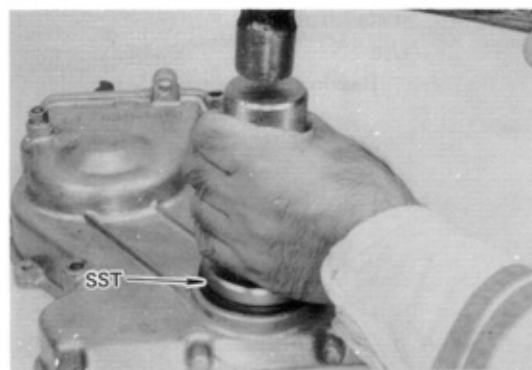
Fig. 4-87



Crankshaft Front Oil Seal Replacement

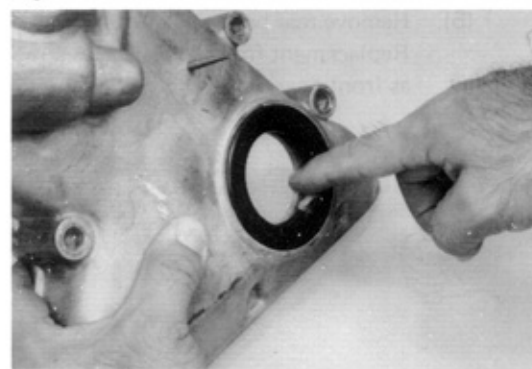
1. Remove oil seal with a screwdriver.

Fig. 4-88



2. Install new oil seal.
Use SST [09223-50010] as shown.

Fig. 4-89



3. After driving in the seal, be sure to coat the seal lip lightly with MP grease.

ASSEMBLY

Assemble in numerical order.

Fig. 4-90

- Thoroughly clean the parts to be assembled.
- Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.

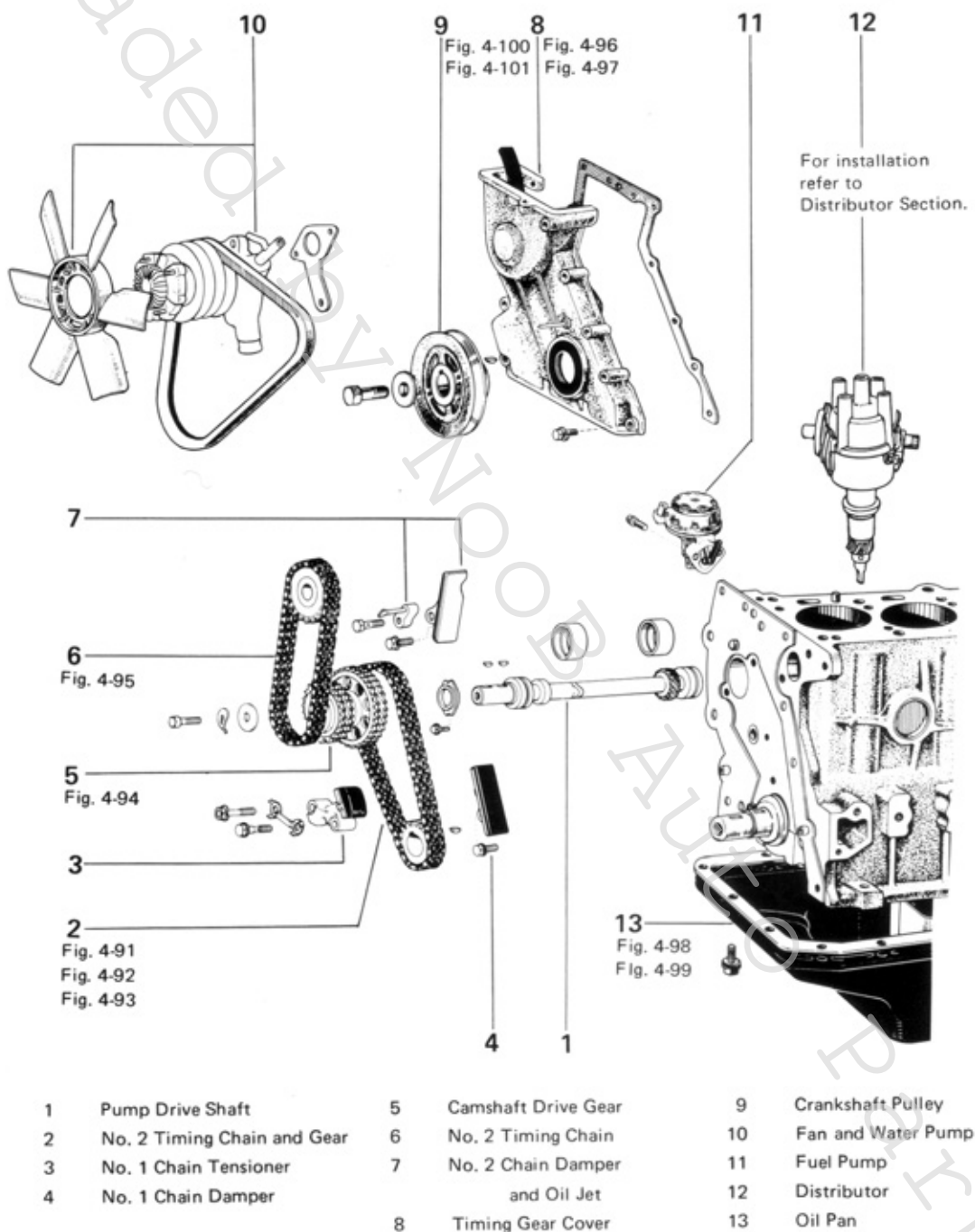
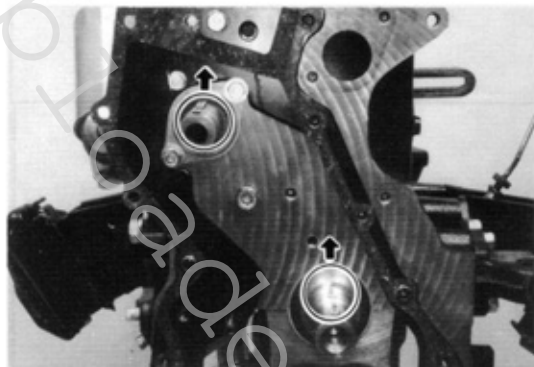


Fig. 4-91



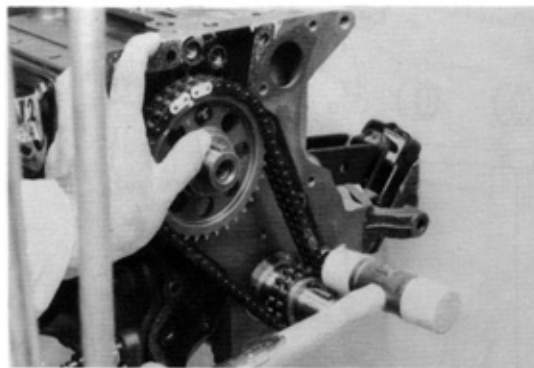
Set the crankshaft keyway and the pump drive shaft keyway vertically upward.

Fig. 4-92



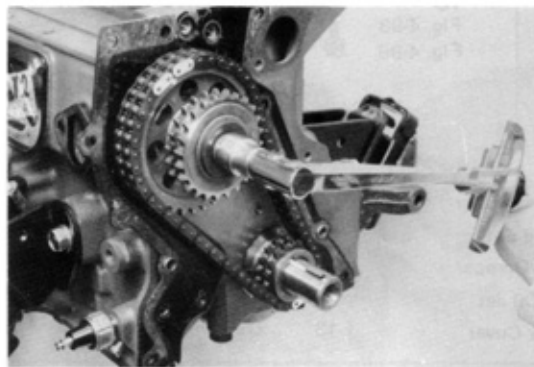
Assemble the crankshaft timing gear and pump drive shaft gear to the No. 2 chain so that their respective marks are aligned.

Fig. 4-93



Drive in No. 1 chain and gears on to the crankshaft and pump driveshaft.

Fig. 4-94



Tighten camshaft drive gear bolt.

Torque

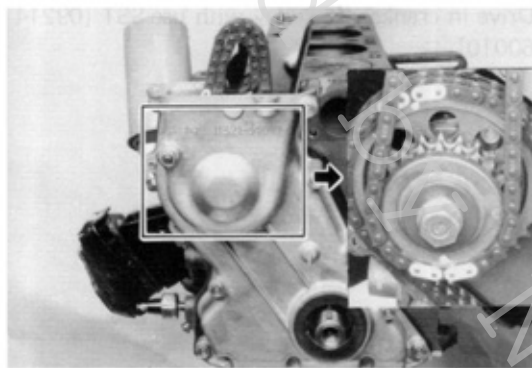
8.0–10.0 kg-m (57.9–72.3 ft-lb)

Fig. 4-95



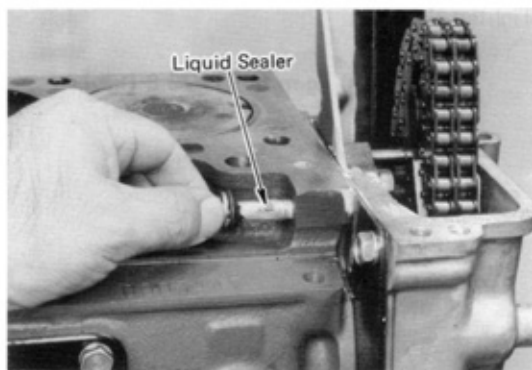
Install No. 2 chain aligned with the chain and gear marks.

Fig. 4-96



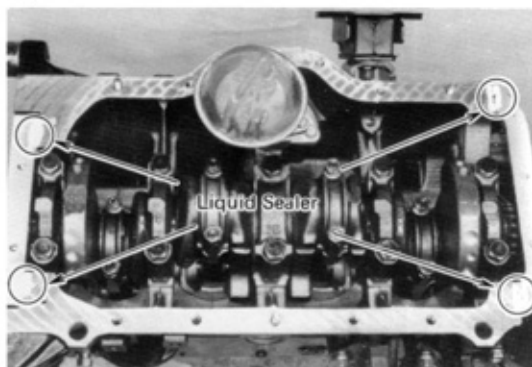
Be careful not to fall the No. 2 chain into the cover.

Fig. 4-97



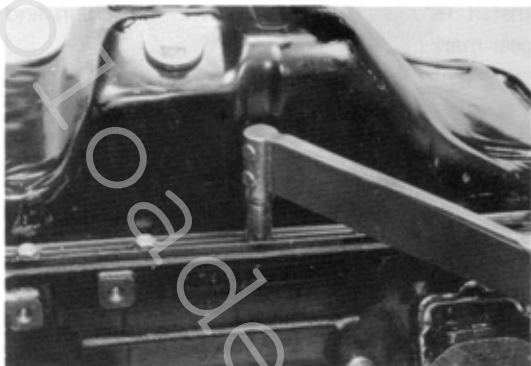
In installing the upper right bolt for mounting the chain cover, insert seal washer and apply liquid sealer on the threads.

Fig. 4-98



Apply liquid sealer as shown.

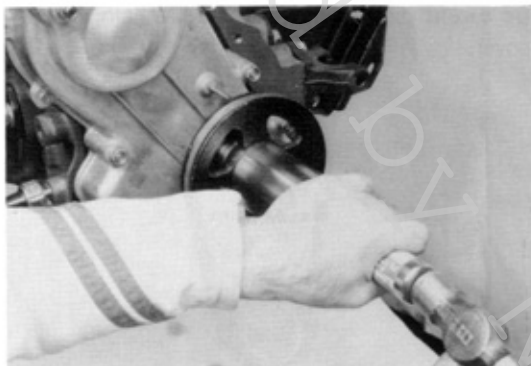
Fig. 4-99



Install oil pan.

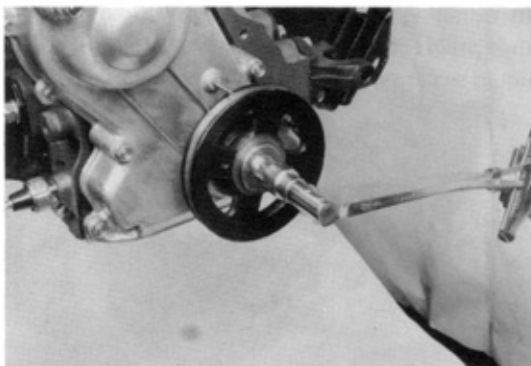
Torque**0.4–0.8 kg-m (2.9–5.8 ft-lb)**

Fig. 4-100



Drive in crankshaft pulley with use SST [09214-60010].

Fig. 4-101



Tighten claw nut.

Torque**9.0–11.0 kg-m (65.1–79.6 ft-lb)**

UpLoaded by NOOB Auto Parts

CYLINDER BLOCK DISASSEMBLY

Disassemble in numerical order

Fig. 4-110

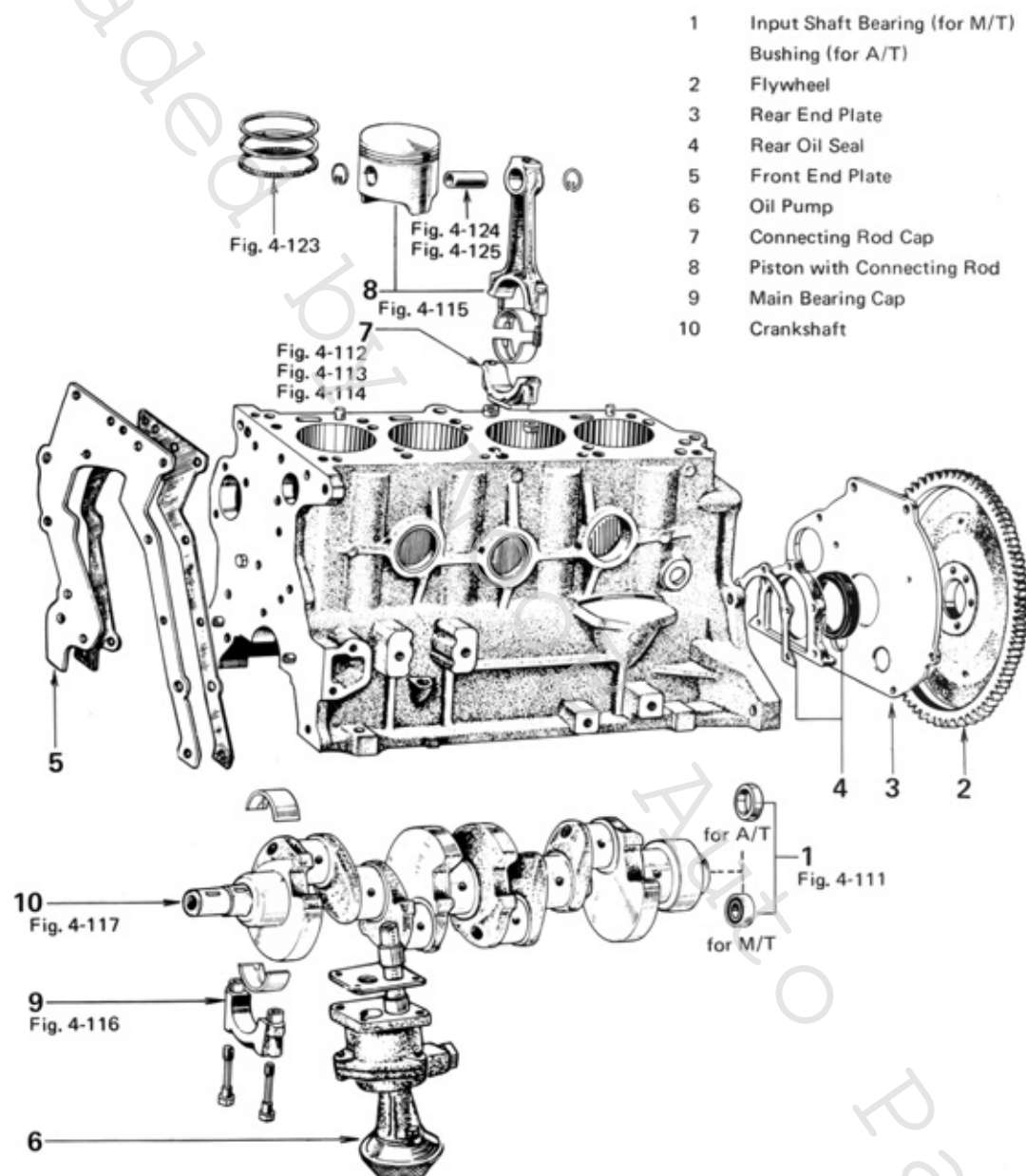
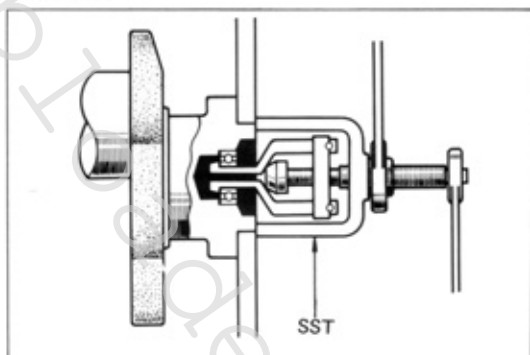
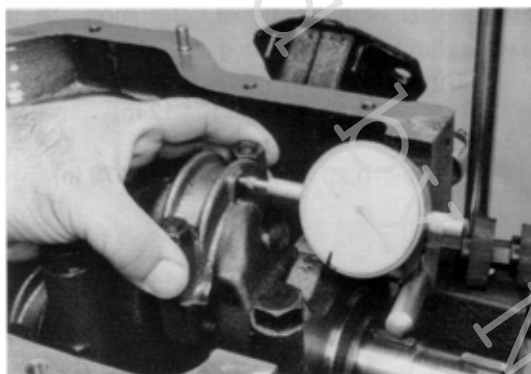


Fig. 4-111



Using SST [09303-35010], remove input shaft bearing.

Fig. 4-112



Measure connecting rod thrust clearance. If it exceeds limit, replace connecting rod.

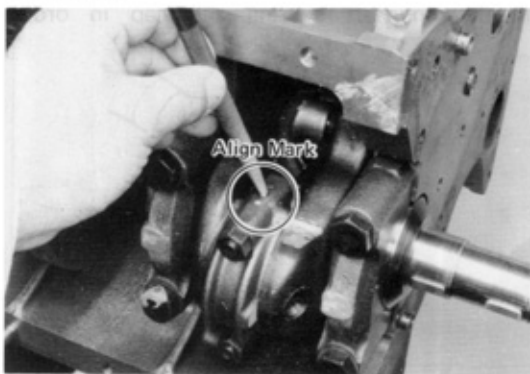
Thrust clearance limit

0.3 mm (0.012 in)

Standard

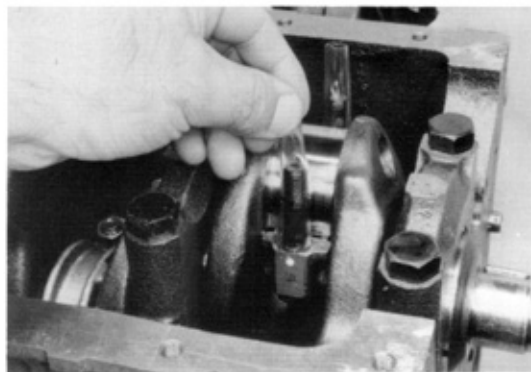
0.16–0.26 mm (0.0063–0.010 in)

Fig. 4-113



Mark connecting rod and cap for correct reassembly.

Fig. 4-114



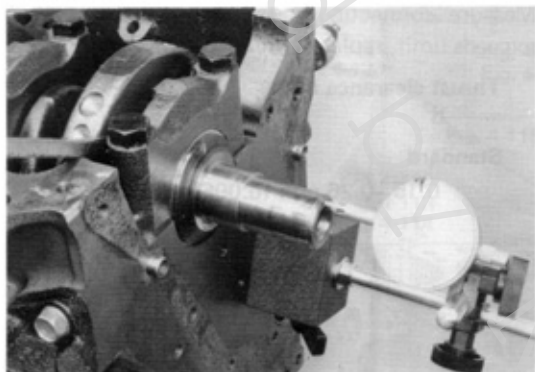
Cover rod bolts with a short length of hose to protect crankshaft from damage.

Fig. 4-115



Keep connecting rod and bearing in order.

Fig. 4-116



Measure crankshaft thrust clearance. If it exceeds limit, replace bearing as a set.

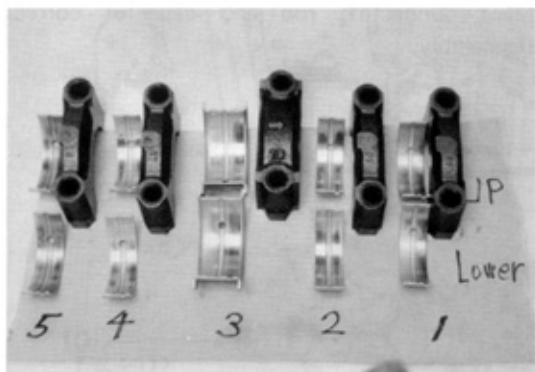
Thrust clearance limit

0.3 mm (0.012 in)

Standard

0.06–0.20 mm (0.0024–0.0079 in)

Fig. 4-117



Keep crankshaft bearing and cap in order.

Fig. 4-118

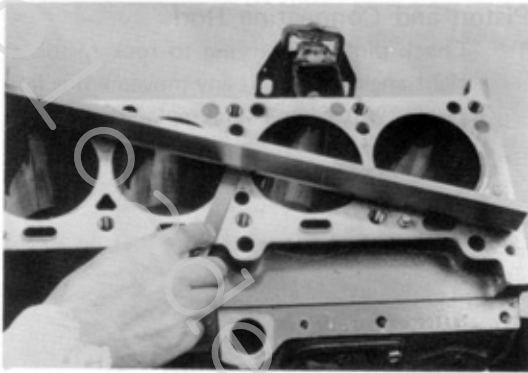


Fig. 4-119

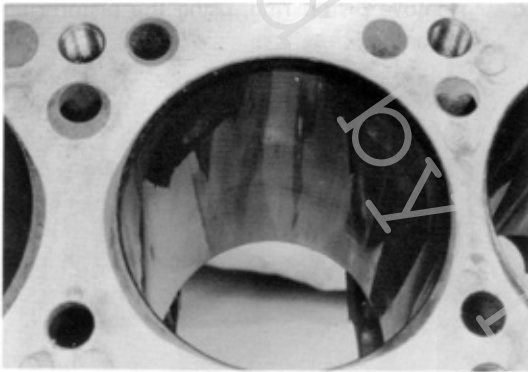


Fig. 4-120

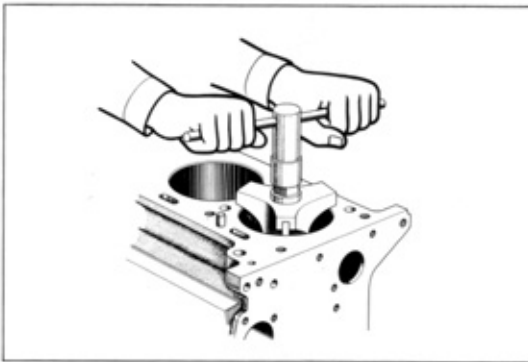
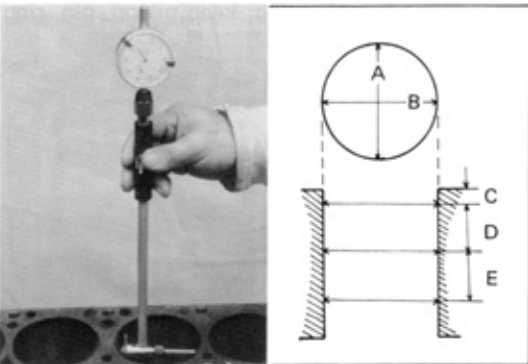


Fig. 4-121

**INSPECTION & REPAIR****Cylinder Block**

1. Check block gasket surface for flatness. If warpage exceeds limit, correct by machining or replace block.

Warpage limit 0.05 mm (0.0019 in)



2. Visually inspect cylinders for vertical scratches. If deep scratches are present, cylinder must be rebored.

3. Machine piston ring ridge from top of cylinder.

— Note —

If this step is not performed prior to removing pistons, piston ring lands will be damaged.



4. Measure cylinder bore at position as shown.

A : Thrust Direction

B : Axial Direction

C : 15 mm (0.59 in)

D : 60 mm (2.36 in)

E : 60 mm (2.36 in)

If bore exceeds specification, it must be rebored.

Wear limit 0.2 mm (0.008 in)

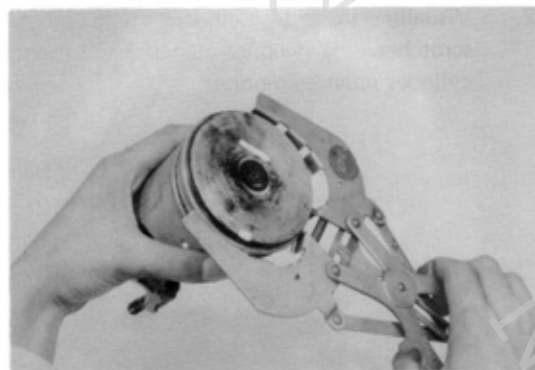
**Standard 88.50–88.55 mm
(3.4842–3.4862 in)**

Fig. 4-122

**Piston and Connecting Rod**

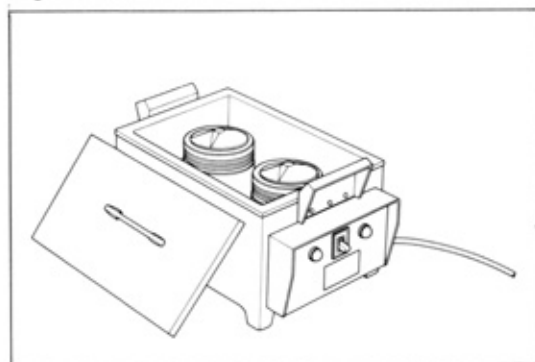
1. Check pin fit by trying to rock piston at right angle to pin. If any movement is felt, piston with pin must be replaced.

Fig. 4-123



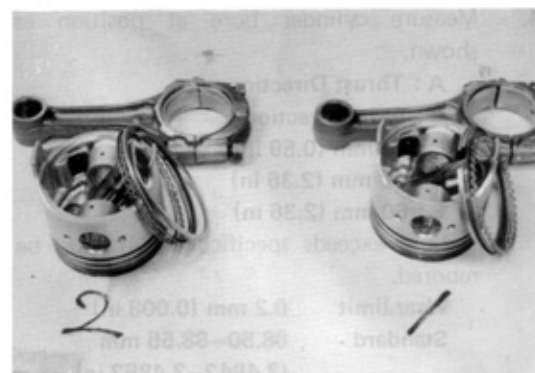
2. Remove piston ring, using the piston ring expander.

Fig. 4-124



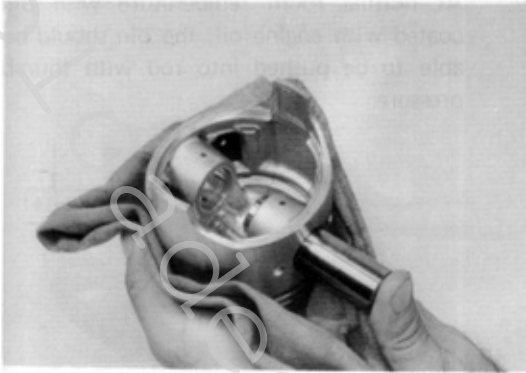
3. Heat piston in piston heater to about 100°C (212°F) and remove piston pin.

Fig. 4-125



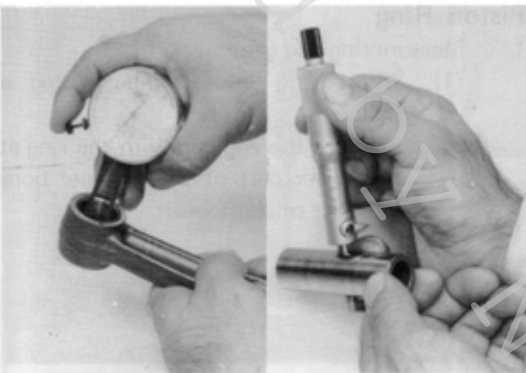
4. After disassembling, keep piston, pin, ring and rod in order.

Fig. 4-126



5. Heat piston to 100°C (212°F) coat pin with engine oil.
The pin should be able to be pushed into piston hole with thumb pressure.

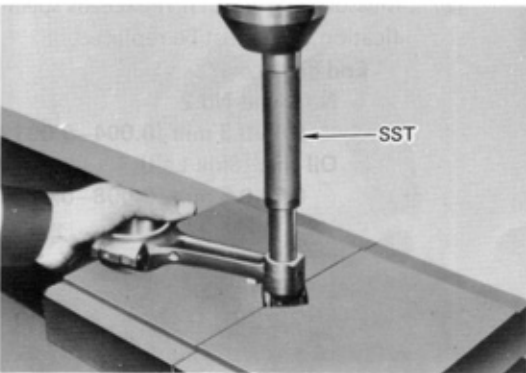
Fig. 4-127



6. Measure oil clearance between bush and pin.

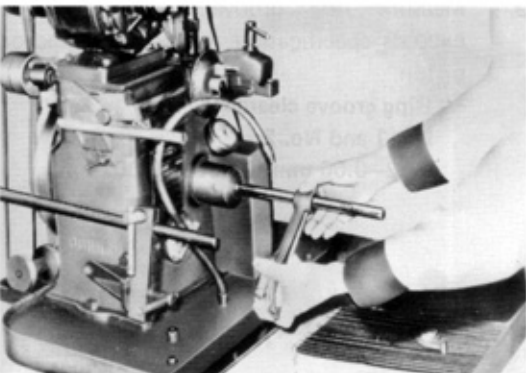
Oil Clearance limit
0.02 mm (0.0008 in)

Fig. 4-128



7. Replace bushing with SST [09222-30010].

Fig. 4-129



8. After pressing in the bushing, finish the bushing bore with a pin hole grinder.

Fig. 4-130

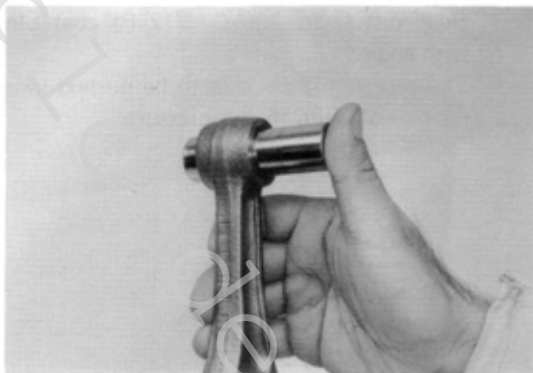


Fig. 4-131

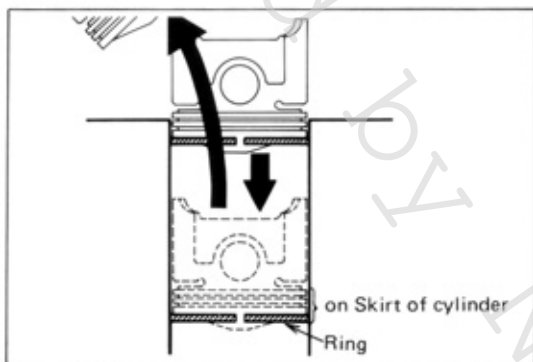


Fig. 4-132

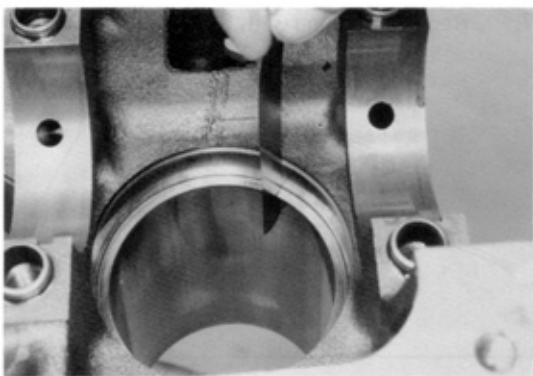


Fig. 4-133



9. At normal room temperature with pin coated with engine oil, the pin should be able to be pushed into rod with thumb pressure.



Piston Ring

1. Measure ring end gap.
 - (1) Insert ring into cylinder using a piston.
Measure the end gap with the ring at the lower part of the cylinder bore with the smallest wear.



- (2) Measure end gap. If it exceeds specification, ring must be replaced.

End gap:

No.1 and No.2

0.1–0.3 mm (0.004–0.0012 in)

Oil ring (Side Lail)

0.2–0.5 mm (0.008–0.020 in)



2. Measure ring groove clearance. If it exceeds specification, replace ring and/or piston.

Ring groove clearance

No. 1 and No. 2

0.02–0.06 mm (0.0008–0.0024 in)

Fig. 4-134

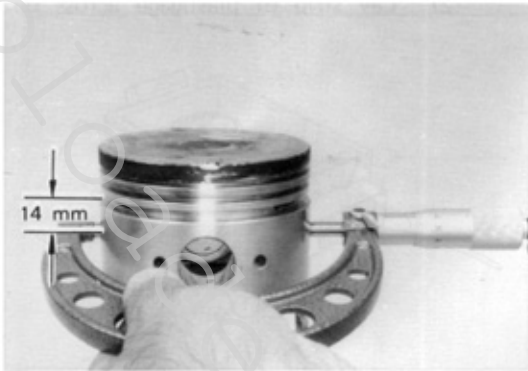


Fig. 4-135

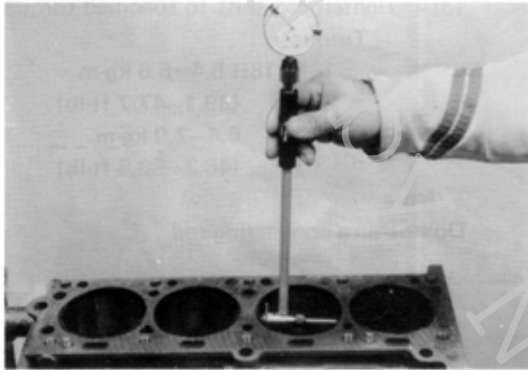


Fig. 4-136

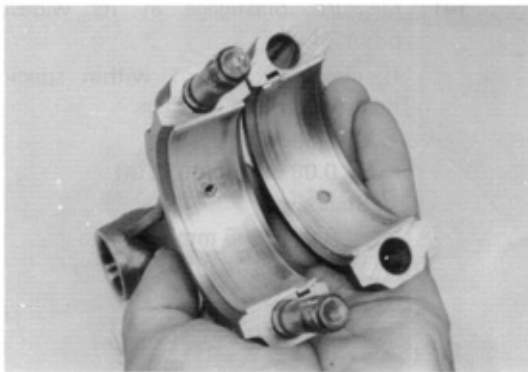
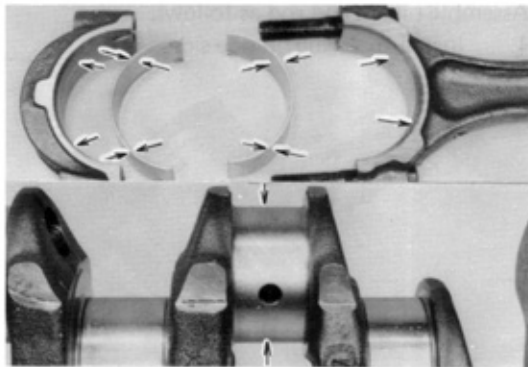


Fig. 4-137

**Piston Clearance**

1. Measure piston diameter at right angle to piston pin center line. Measurement must be made at normal temperature (20°C or 68°F).

Piston diameter (STD)

88.44–88.49 mm

(3.4819–3.4839 in)



2. Measure cylinder bore and subtract piston measurement. If clearance exceeds specification, replace piston.

Piston clearance

0.05–0.07 mm (0.0020–0.0028 in)

**Crankpin and Bearing**

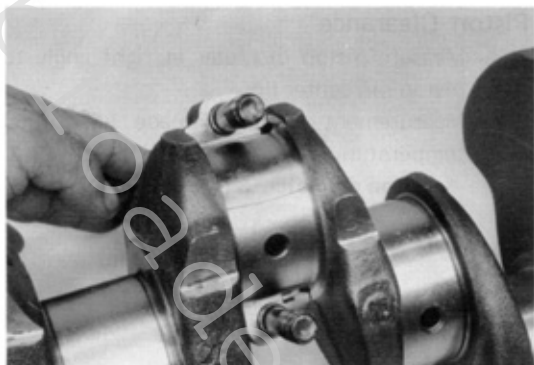
1. Inspect bearings for flaking or scoring. If bearings are damaged, replace.



2. Measure crankpin oil clearance.

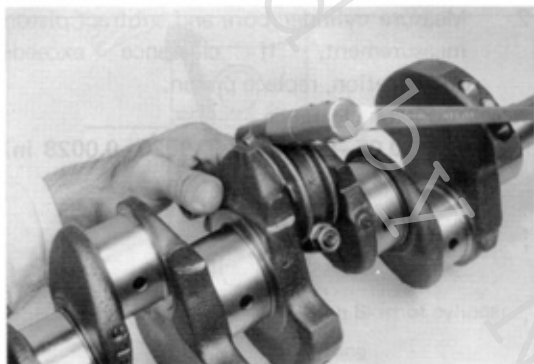
(1) Clean crankshaft pin, rod, cap and bearing.

Fig. 4-138



- (2) Lay strip of plastigage across pin.

Fig. 4-139



- (3) Tighten cap nuts to specified torque.

Torque

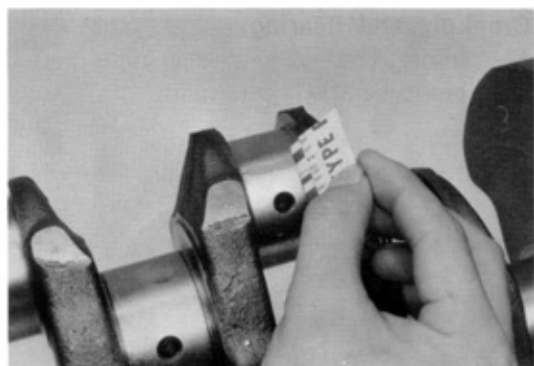
16R, 18R 5.4–6.6 kg-m
(39.1–47.7 ft-lb)

18R-G 6.4–7.0 kg-m
(46.3–50.6 ft-lb)

— Note —

Do not turn connecting rod.

Fig. 4-140



- (4) Measure plastigage at its widest point.

If clearance is not within specification, replace bearings.

Clearance limit

0.08 mm (0.0032 in)

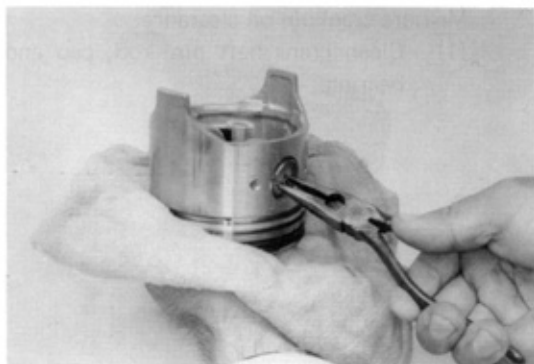
Standard

0.02–0.05 mm
(0.0008–0.0020 in)

U/S Bearing sizes

U/S 0.05, 0.25, 0.50

Fig. 4-141



Assemble piston and rod as follows.

1. Install snap ring on one side.

Fig. 4-142

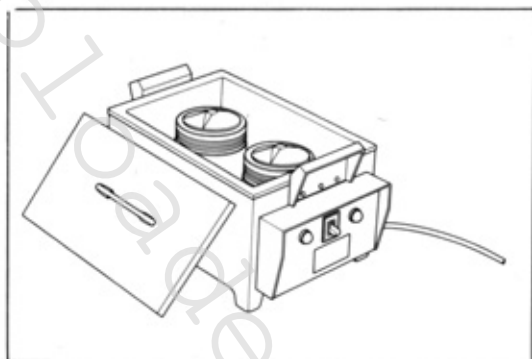


Fig. 4-143



Fig. 4-144

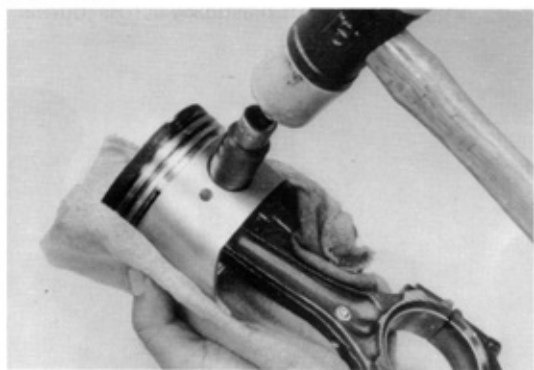


Fig. 4-145



2. Heat piston to about 100° (212°F).



3. Aligning piston notch and rod mark as shown.

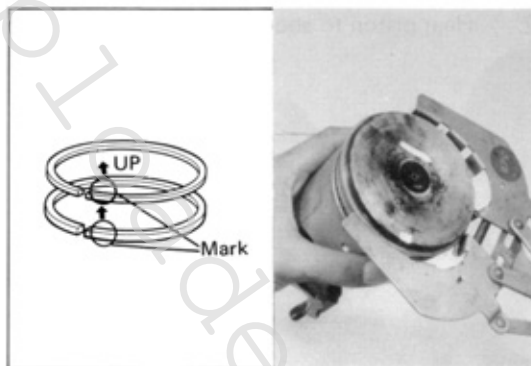


4. Install piston pin.



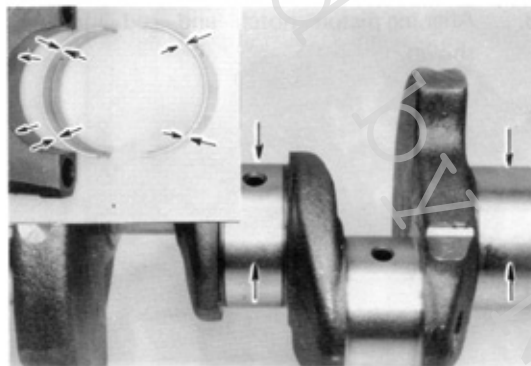
5. Install snap ring on other side.
Make sure snap ring is completely in place.

Fig. 4-146



6. Install piston ring, using piston ring expander.
Install two compression rings with code marks facing up.

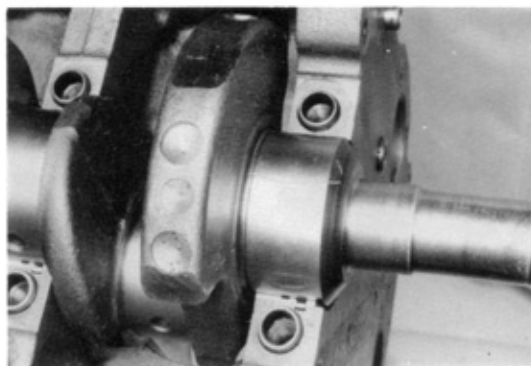
Fig. 4-147



Crankshaft and Bearing

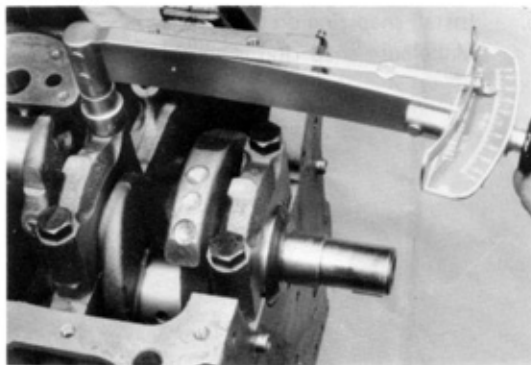
1. Measure crankshaft oil clearance.
 - (1) Clean journal, cap and bearing

Fig. 4-148



- (2) Lay strip of plastigage across journal.

Fig. 4-149



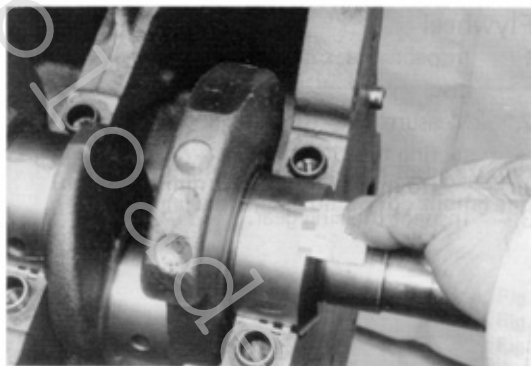
- (3) Tighten cap nuts to specified torque.

Torque	16R, 18R
	9.5–11.5 kg-m
	(68.7–83.2 ft-lb)
18R-G	10.0–11.0 kg-m
	(72.3–79.6 ft-lb)

— Note —

Do not turn crankshaft.

Fig. 4-150



- (4) Measure plastigage at its widest point. If clearance is not within specification, replace bearing.

Clearance limit

0.08 mm (0.0032 in)

Standard

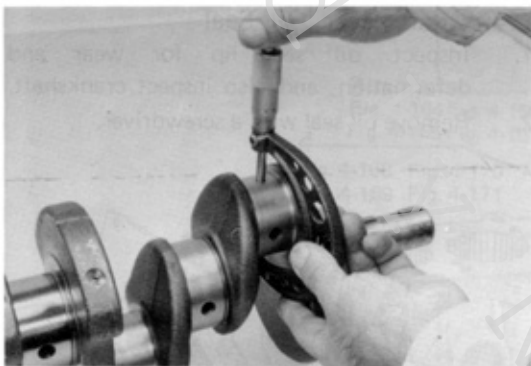
0.02–0.05 mm

(0.0008–0.0020 in)

U/S bearing sizes

U/S 0.05, 0.25, 0.50

Fig. 4-151

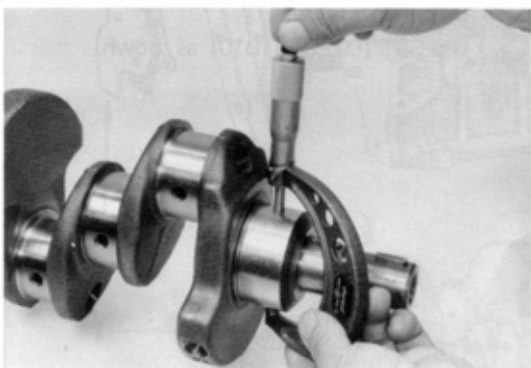


2. Measure crankpin journal. If wear is excessive, crankshaft must be reground or replaced.

Crankpin Journal Size

STD	52.976–53.000 mm (2.0857–2.0867 in)
U/S 0.25	52.70–52.71 mm (2.0748–2.0752 in)
U/S 0.50	52.45–52.46 mm (2.0650–2.0654 in)

Fig. 4-152

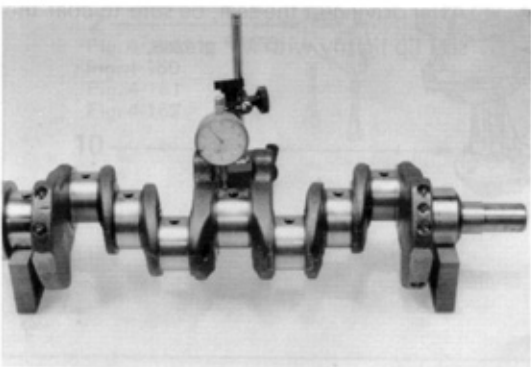


3. Measure crankshaft main journal. If wear is excessive, crankshaft must be reground or replace.

Crankshaft Main Journal Size

STD	59.976–60.000 mm (2.3613–2.3622 in)
U/S 0.25	59.70–59.71 mm (2.3504–2.3508 in)
U/S 0.50	59.45–59.46 mm (2.3406–2.3409 in)

Fig. 4-153



4. Check crankshaft for runout and if it exceeds limit, replace.

Run out limit 0.05 mm (0.0020 in)

Fig. 4-154

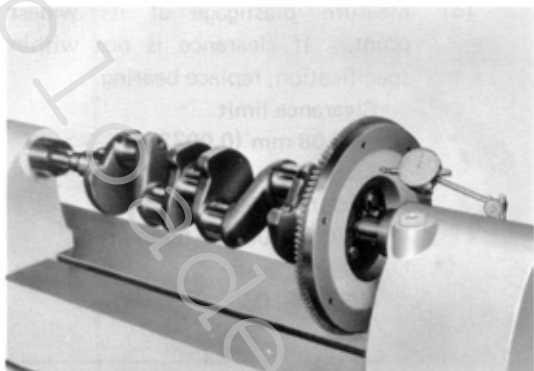


Fig. 4-155



Fig. 4-156

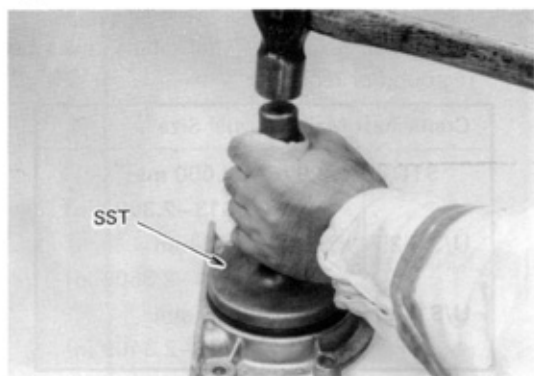
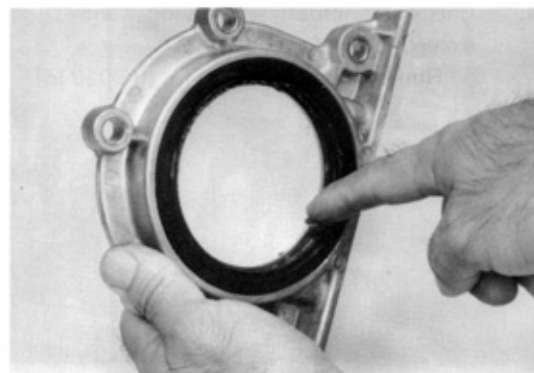


Fig. 4-157

**Flywheel**

1. Inspect the surface contacting the clutch disc.
2. Measure the runout of the surface contacting the clutch disc.

Runout limit 0.2 mm (0.008 in)

3. Inspect the ring gear.

**Crankshaft Rear Oil Seal**

1. Inspect oil seal lip for wear and deformation, and also inspect crankshaft.
2. Remove oil seal with a screwdriver.



3. Install new oil seal.
Use SST [09223-41010] as shown.



4. After driving in the seal, be sure to coat the seal lip lightly with MP grease.

ASSEMBLY

Assemble in numerical order

Fig. 4-158

- Thoroughly clean the parts to be assembled.
- Apply clean engine oil on the sliding and rotating surfaces of the parts before assembly.

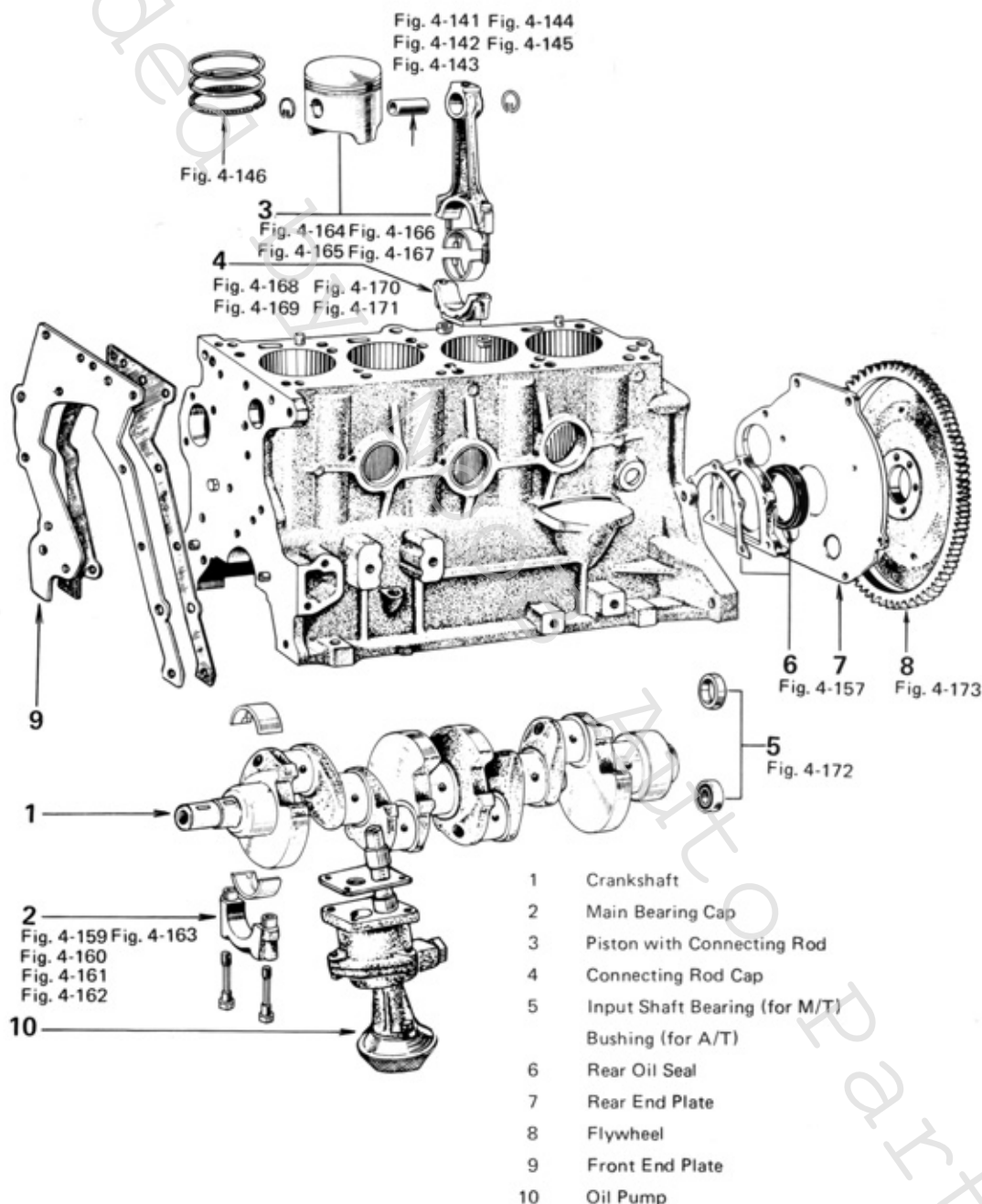
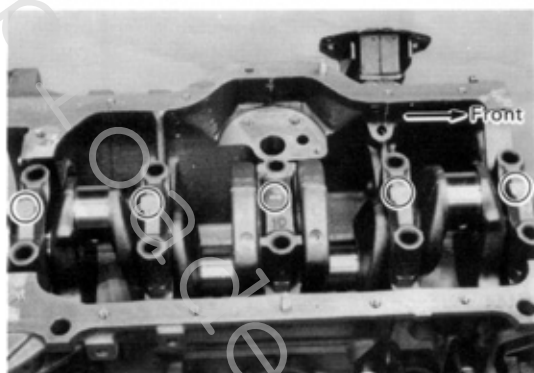
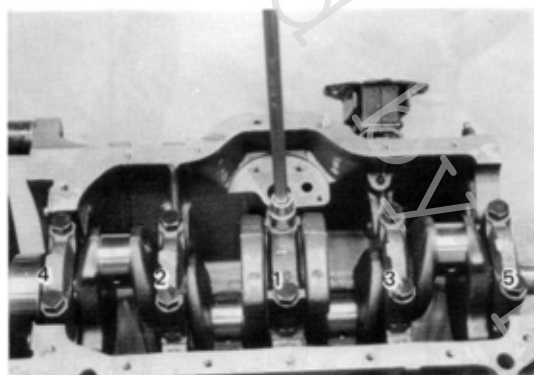


Fig. 4-159



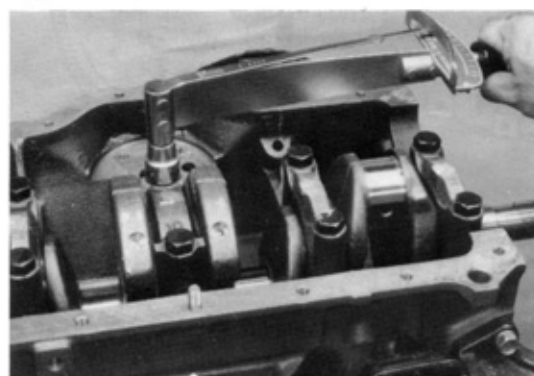
Face the arrow mark toward front.

Fig. 4-160



Gradually tighten bearing cap bolts in 2 to 3 stages as shown.

Fig. 4-161

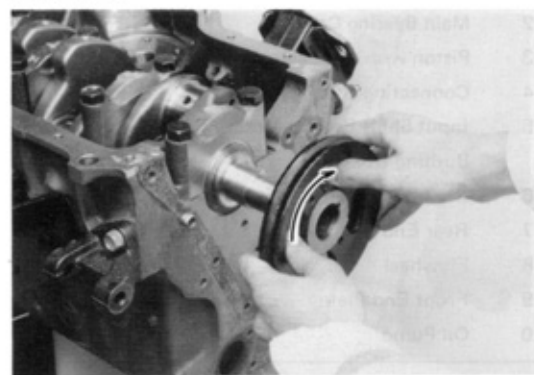


Tighten bearing caps to specified torque.

Torque

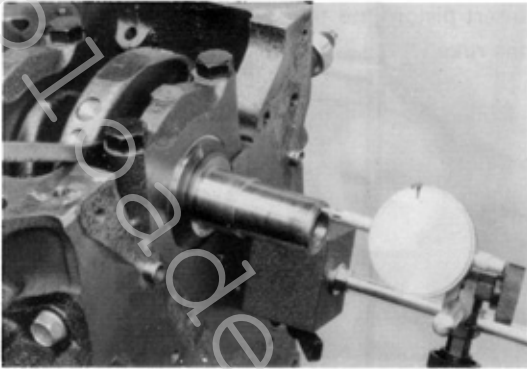
16R, 18R	9.5–11.5 kg-m (68.7–83.2 ft-lb)
18R-G	10.0–11.0 kg-m (72.3–79.6 ft-lb)

Fig. 4-162



Make sure crankshaft rotates smoothly.

Fig. 4-163



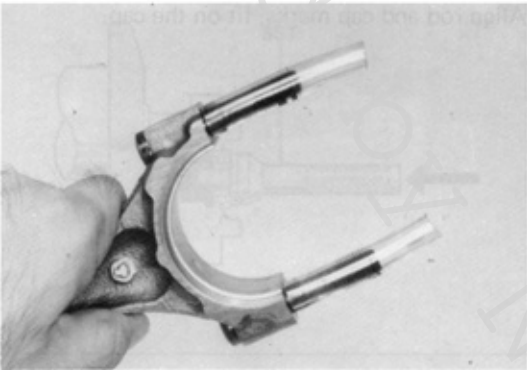
Make sure crankshaft thrust clearance.

Thrust clearance

Limit 0.3 mm (0.0118 in)

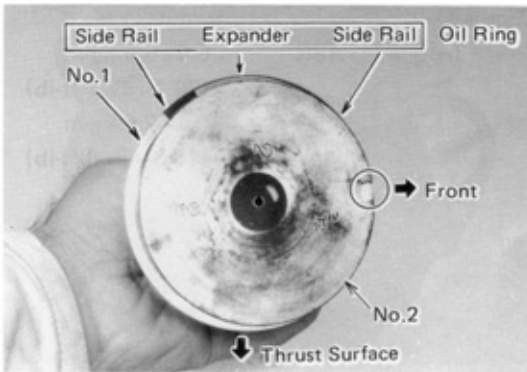
Standard 0.002–0.20 mm
(0.0008–0.0079 in)

Fig. 4-164



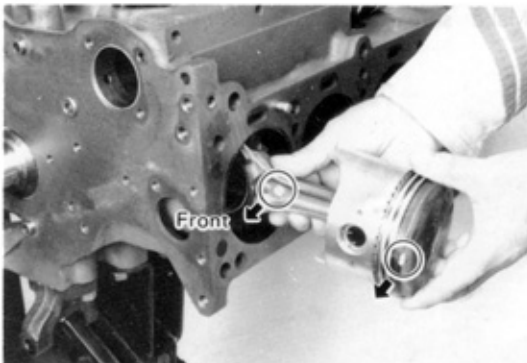
Cover rod bolts with a hose to protect crankpin from damage.

Fig. 4-165



Position ring gap in direction as shown.

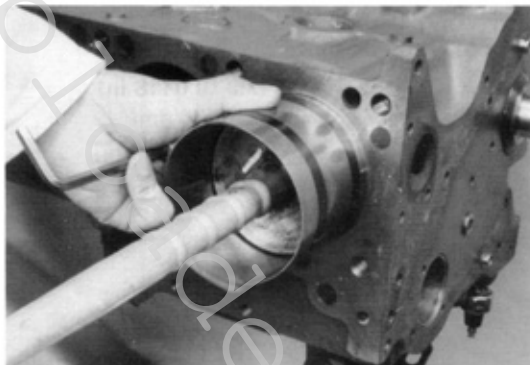
Fig. 4-166



Push correctly numbered piston/rod assembly with notch forward.

Mark on connecting rod should face forward.

Fig. 4-167



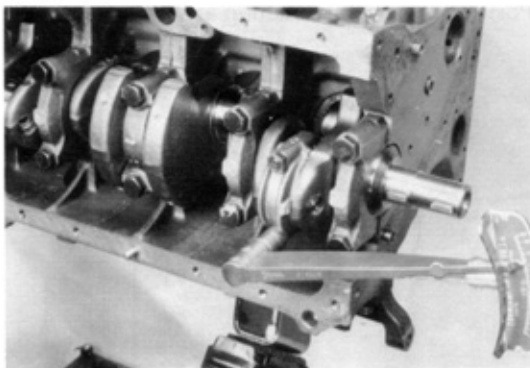
Insert piston into the cylinder while compressing the rings with a piston ring compressor.

Fig. 4-168



Align rod and cap marks, fit on the cap.

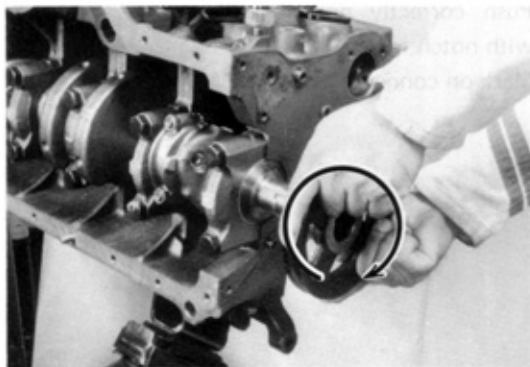
Fig. 4-169



Tighten rod cap to specified torque.

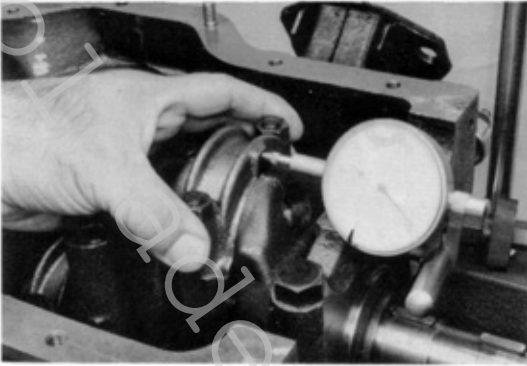
Torque	18R	5.4–6.6 kg-m (39.1–47.7 ft-lb)
	18R-G	6.4–7.0 kg-m (46.3–50.6 ft-lb)

Fig. 4-170



Make sure the crankshaft rotates smoothly.

Fig. 4-171



Check connecting rod thrust clearance.

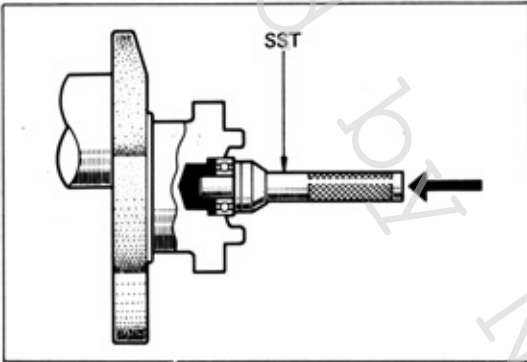
Thrust clearance limit

0.3 mm (0.012 in)

Standard 0.16–0.26 mm

(0.0063–0.0102 in)

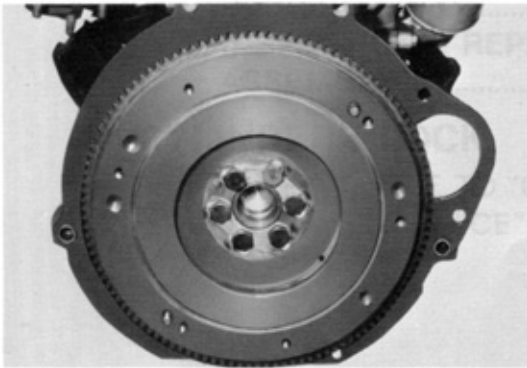
Fig. 4-172



Drive in input shaft bearing.

Use SST [09304-30012].

Fig. 4-173



Tighten flywheel to specified torque.

Torque	18R	7.0–8.0 kg-m (50.6–57.9 ft-lb)
	18R-G	8.2–8.8 kg-m (59.3–63.7 ft-lb)

UpLoaded by Noob Auto Parts

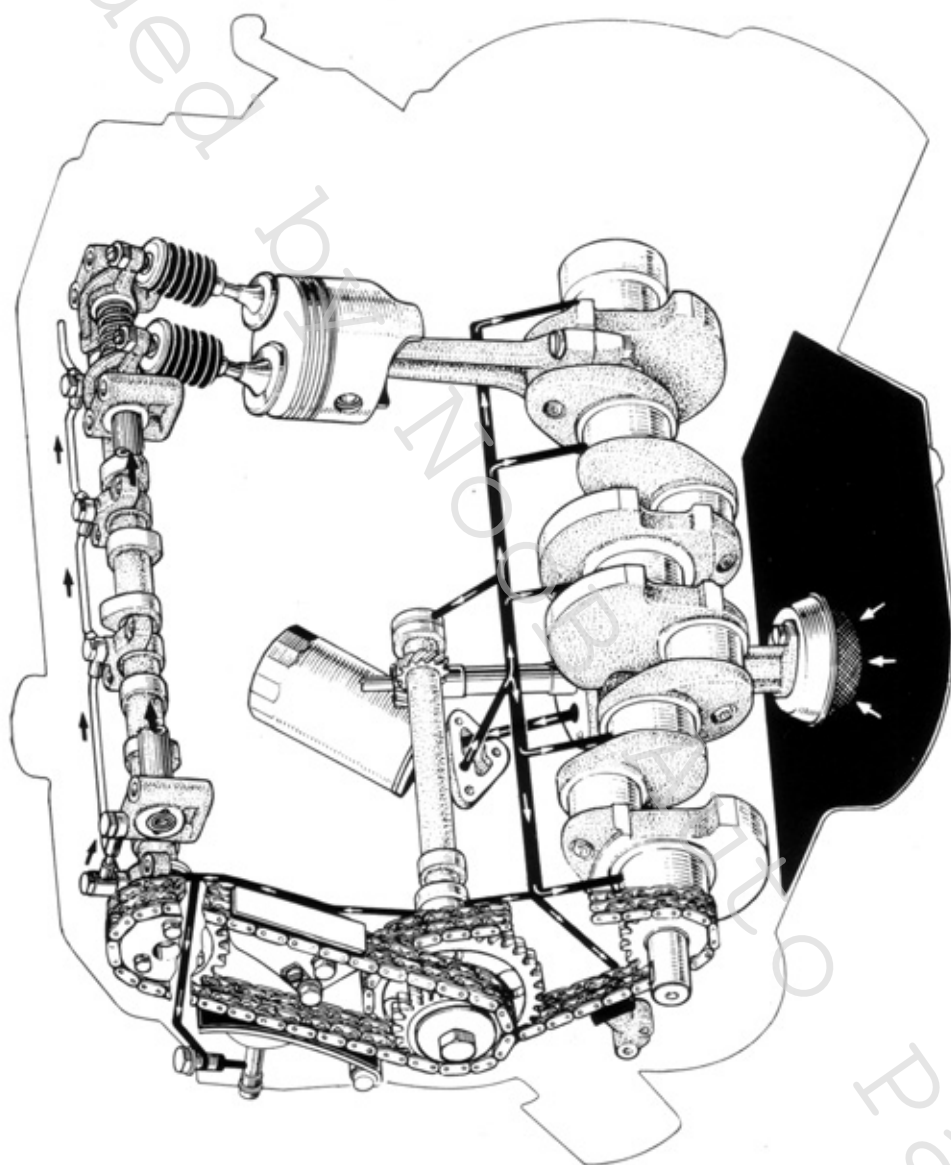
LUBRICATING SYSTEM

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LUBRICATING SYSTEM CIRCUIT

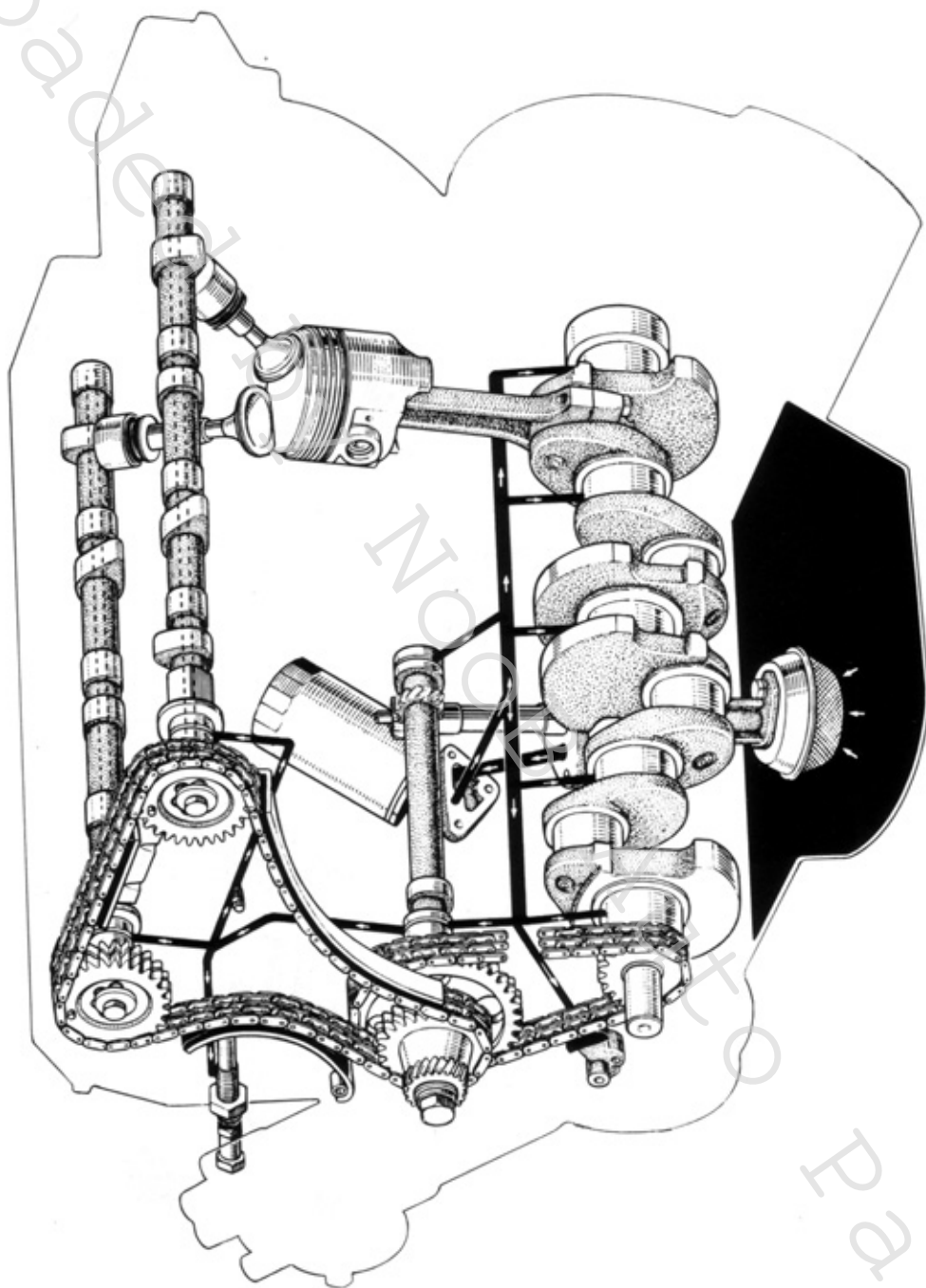
16R, 18R ENGINE

Fig. 6-1



18R-G ENGINE

Fig. 6-2

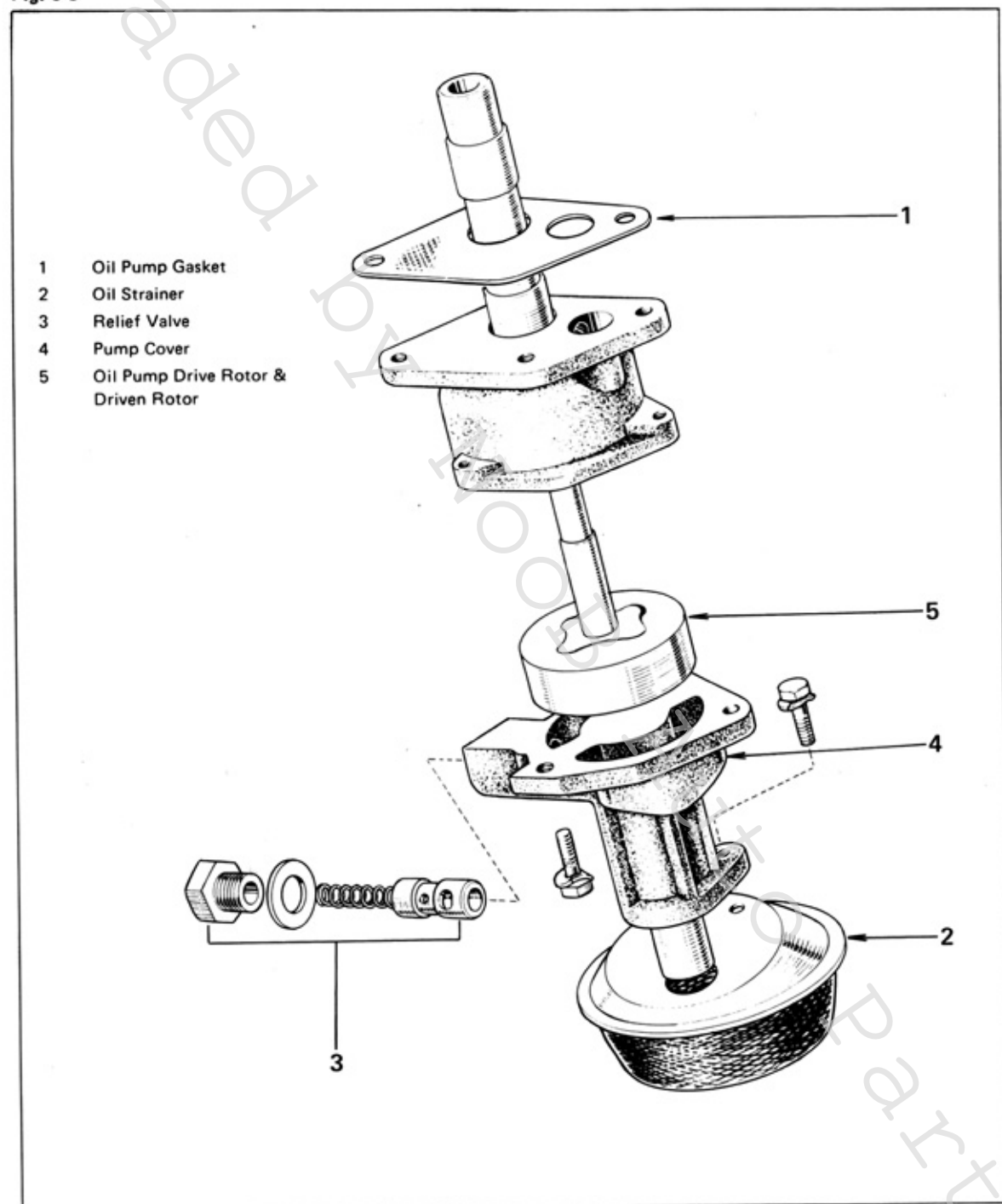


OIL PUMP

DISASSEMBLY (FOR 16R, 18R ENGINE)

Disassemble in numerical order.

Fig. 6-3



DISASSEMBLY (FOR 18R-G ENGINE)

Disassemble in numerical order.

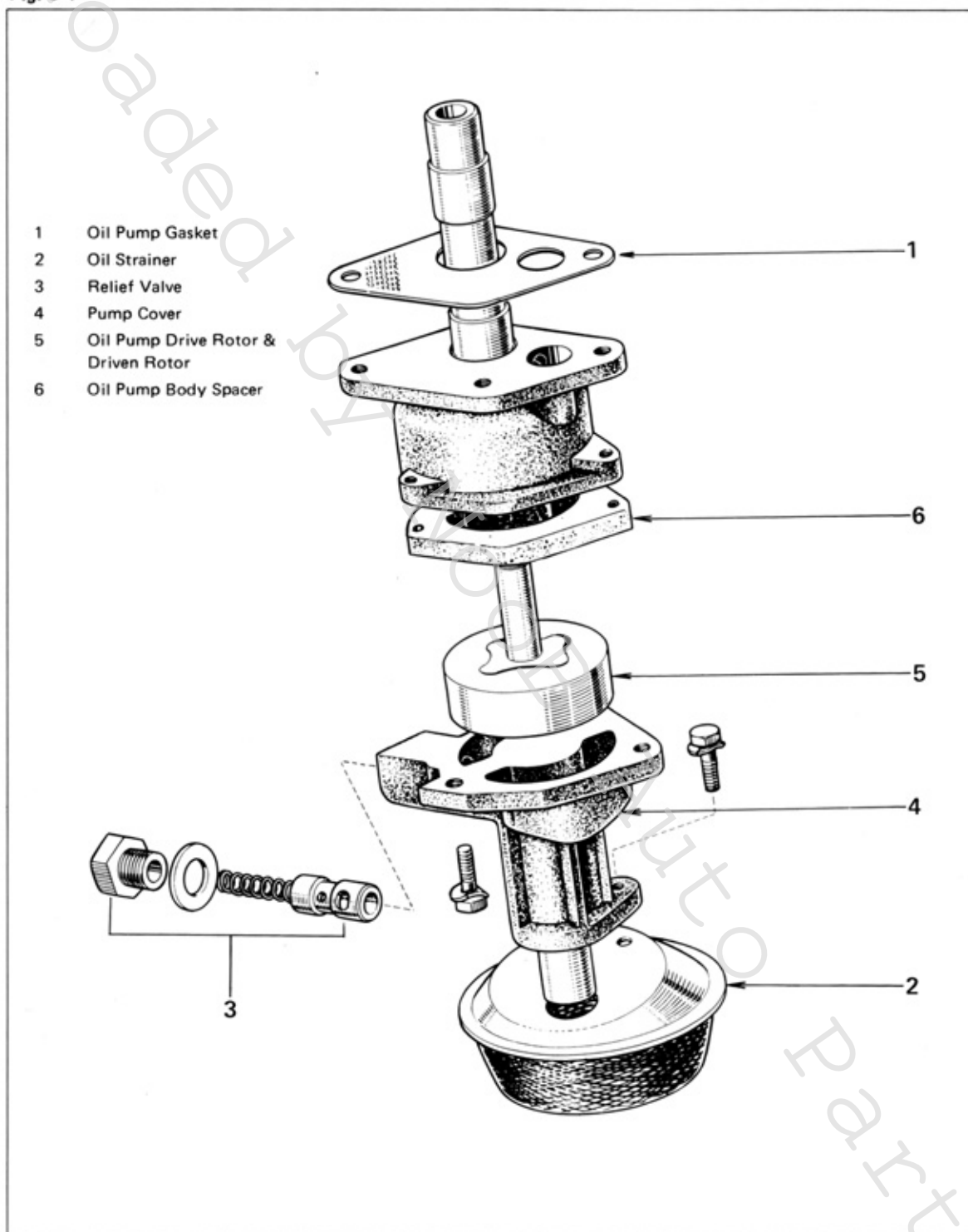
Fig. 6-4

Fig. 6-5

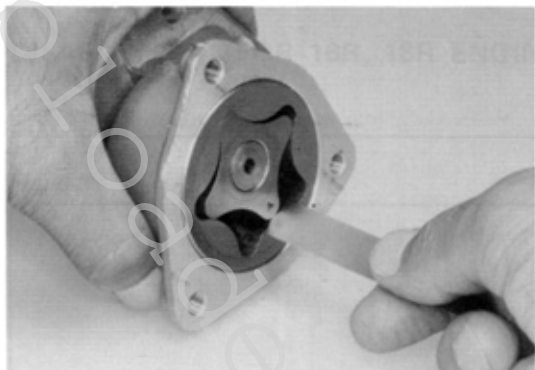


Fig. 6-6

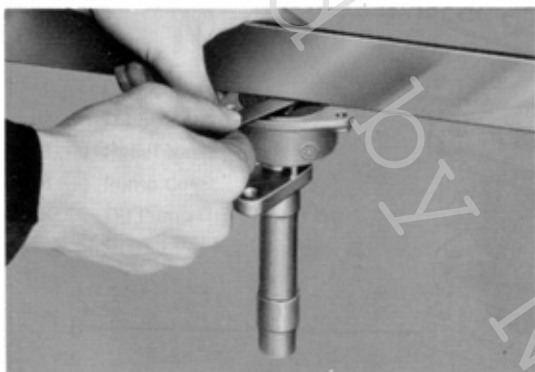


Fig. 6-7

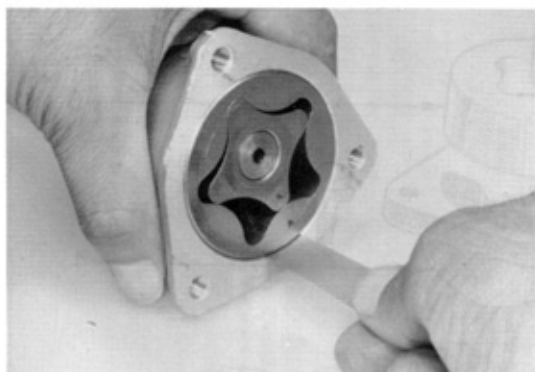
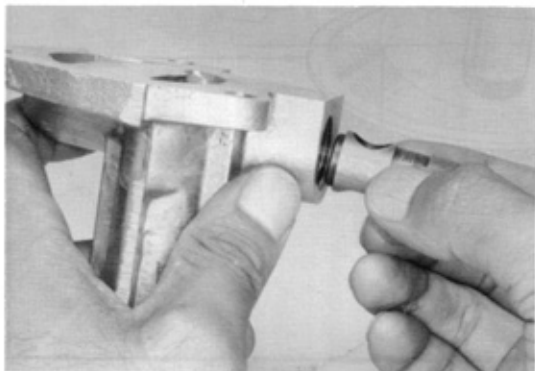


Fig. 6-8



INSPECTION



1. Measure the tip clearance. If it exceeds limit, replace the oil pump drive rotor set.

Limit**0.2 mm (0.008 in)****Standard****0.10–0.15 mm (0.0039–0.0059 in)**

2. Measure the side clearance (between rotor and cover). If it exceeds limit, replace either rotor or pump body.

Limit**0.15 mm (0.0059 in)****Standard****0.03–0.07 mm (0.0012–0.0028 in)**

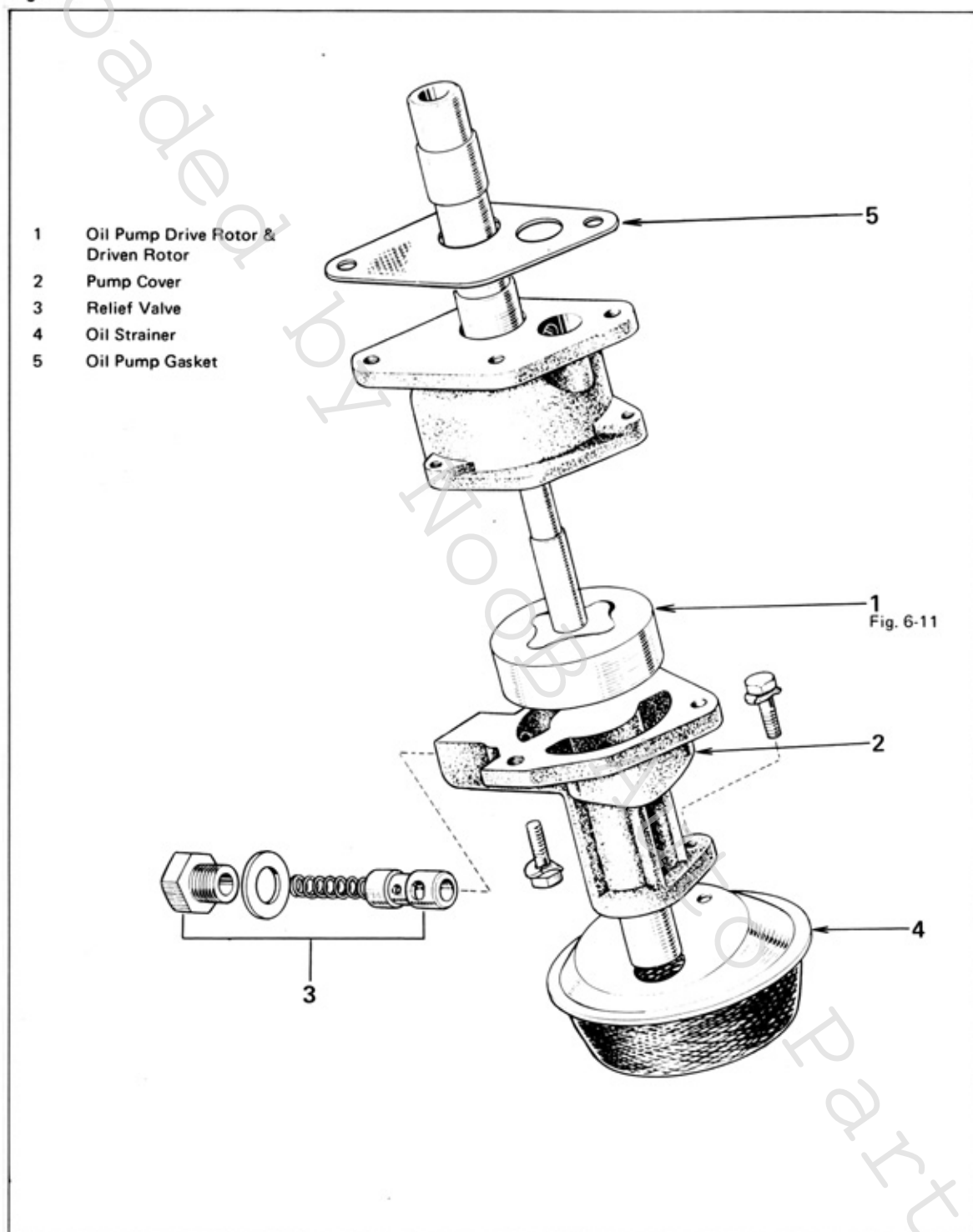
3. Measure the body clearance (between driven rotor and pump body). If it exceeds limit, replace either rotor or pump body.

Limit**0.2 mm (0.008 in)****Standard****0.10–0.16 mm (0.0039–0.0063 in)**

4. Inspect relief valve for scoring and wear. If damaged, replace valve or pump assembly.

ASSEMBLY (FOR 16R, 18R ENGINE)

Assemble in numerical order.

Fig. 6-9

ASSEMBLY (FOR 18R-G ENGINE)

Assemble in numerical order.

Fig. 6-10

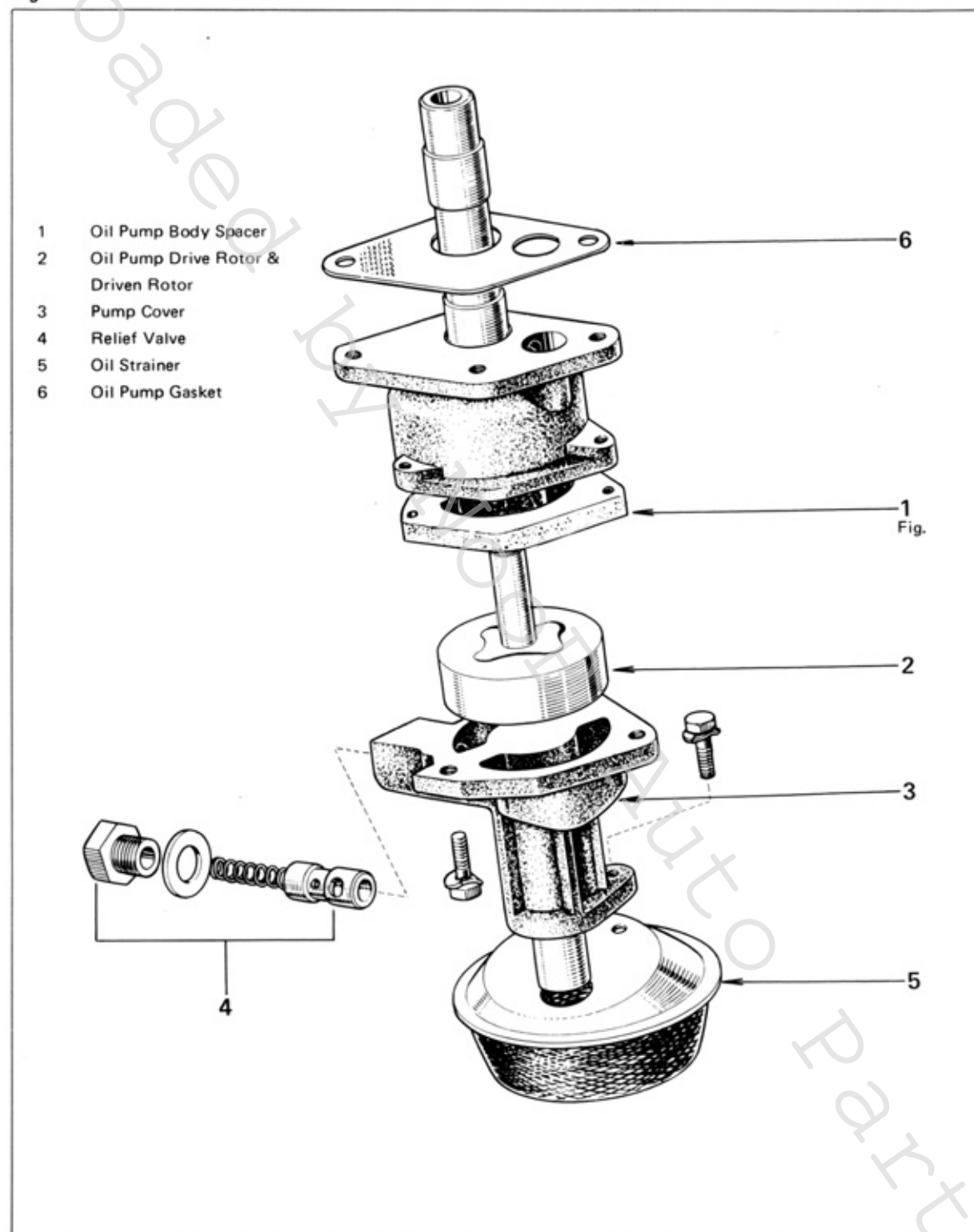
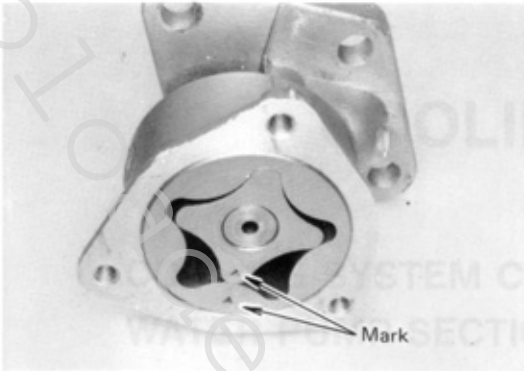


Fig. 6-11



Assemble the rotors so that the punch marks will be facing the pump cover.

Fig. 6-12



Check pump operation

Immerse the pump suction end into fresh engine oil, and turn the shaft clockwise with a screwdriver.

This should cause the oil to come out of discharge hole.

Close the discharge hole with thumb, and turn the shaft as before. Make sure that the shaft becomes heavy.

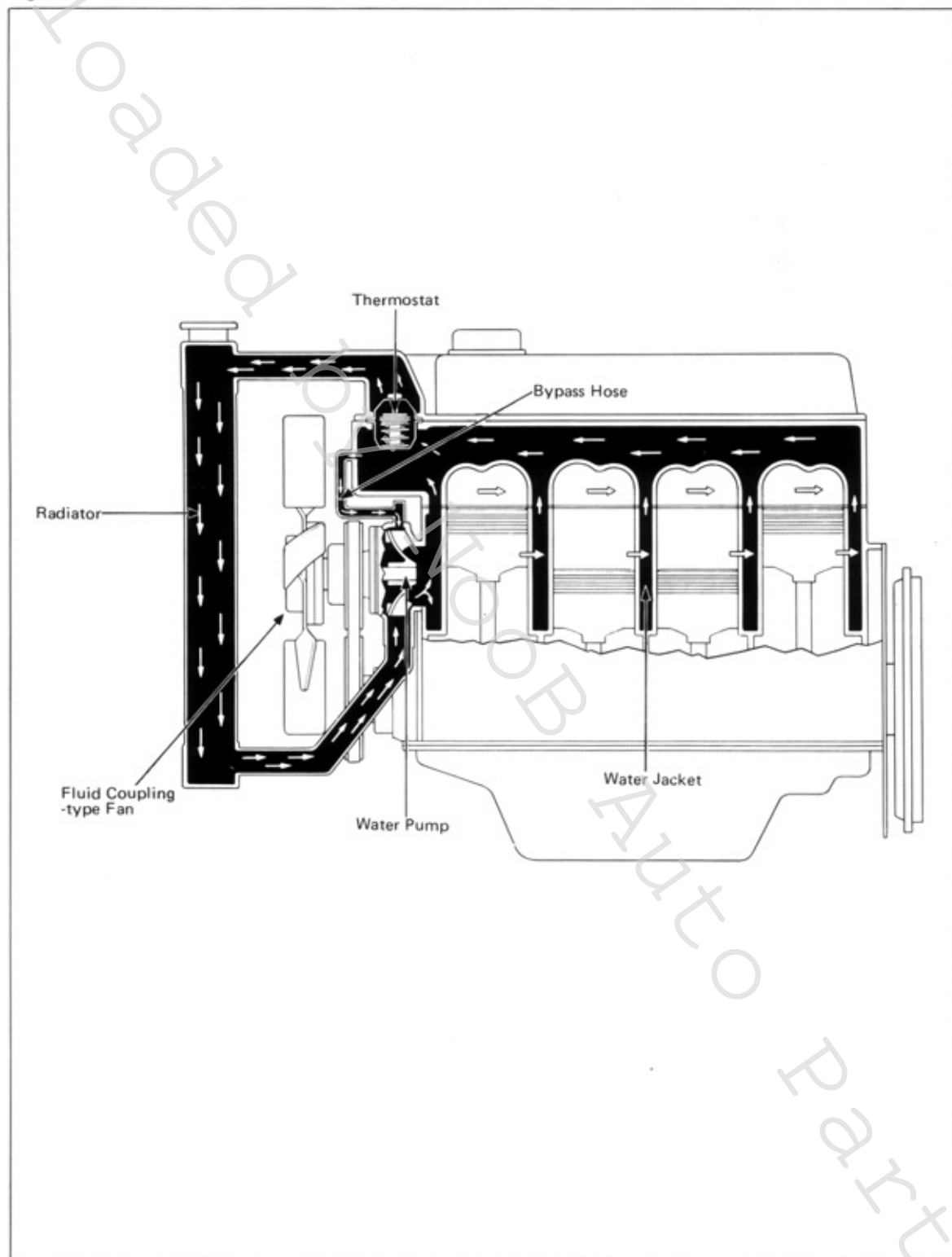
UpLoaded by Noob Auto Parts

COOLING SYSTEM

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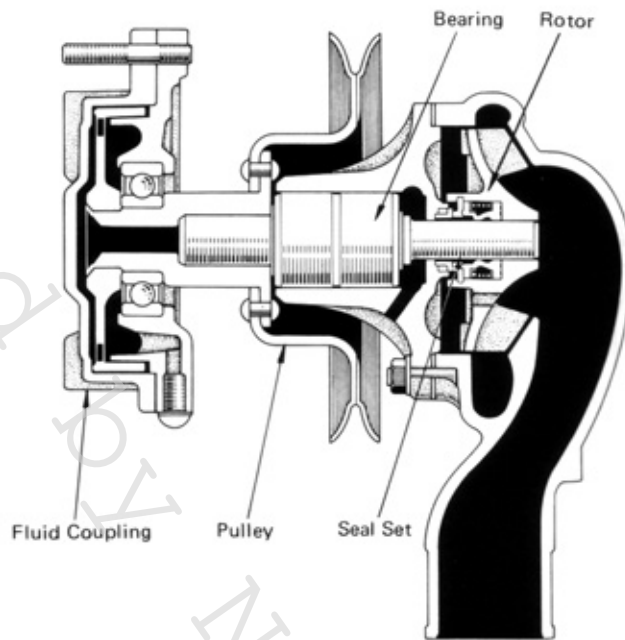
COOLING SYSTEM CIRCUIT

Fig. 7-1

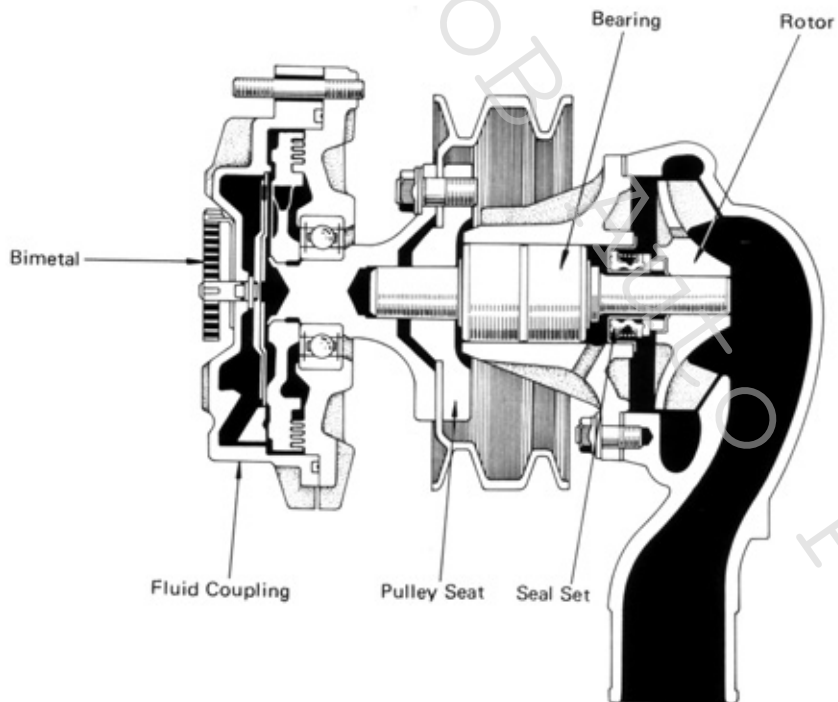


WATER PUMP SECTIONAL VIEW

Fig. 7-2



WITHOUT TEMPERED COOLING FAN



WITH TEMPERED COOLING FAN

WATER PUMP(WITHOUT TEMPERED COOLING FAN) DISASSEMBLY

Disassemble in numerical order.

Fig. 7-3

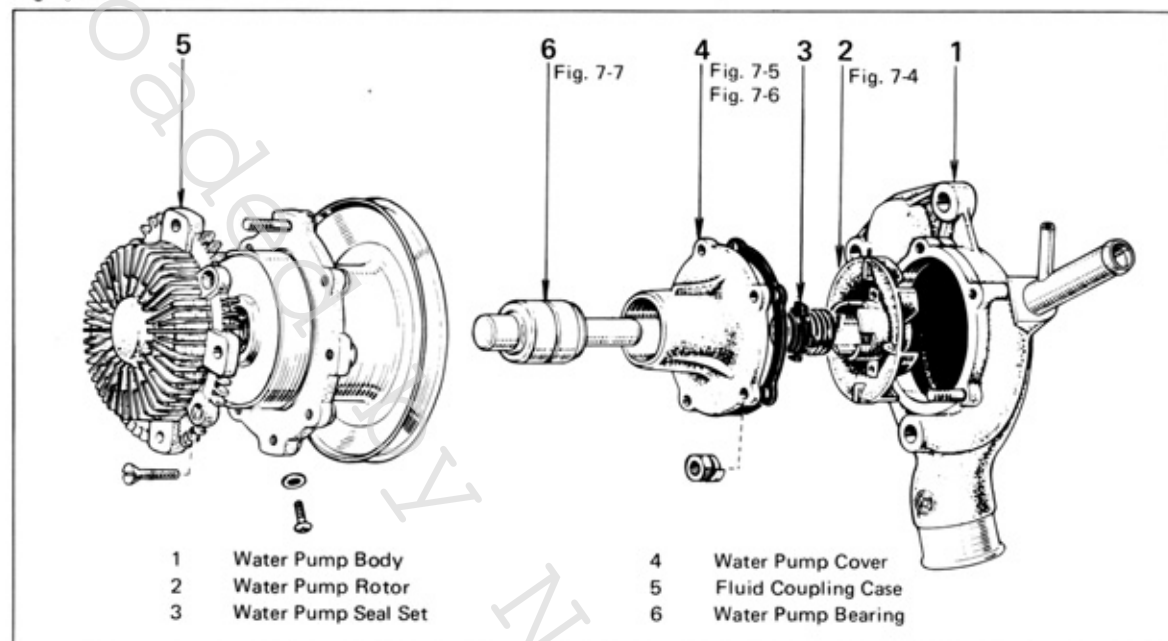
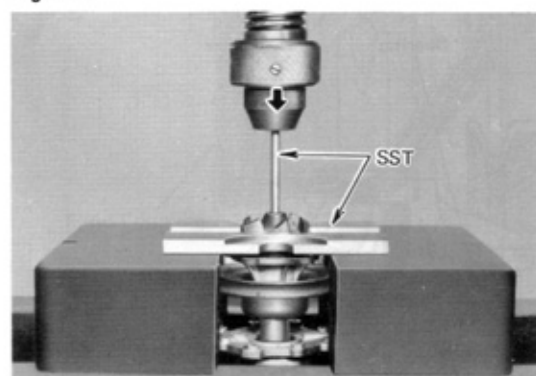
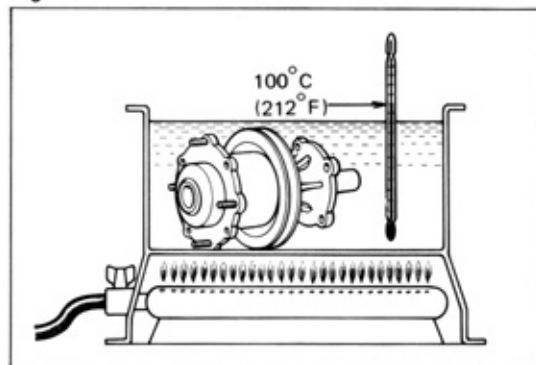


Fig. 7-4



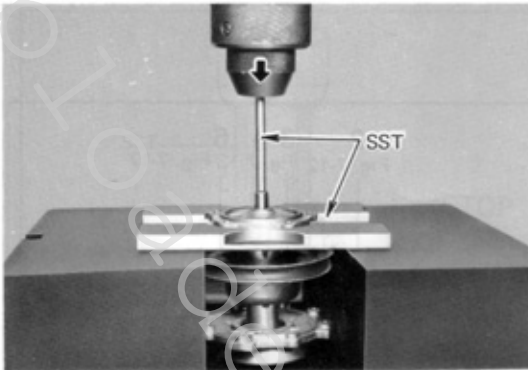
Using SST [09236-36010] and press, remove the rotor.

Fig. 7-5



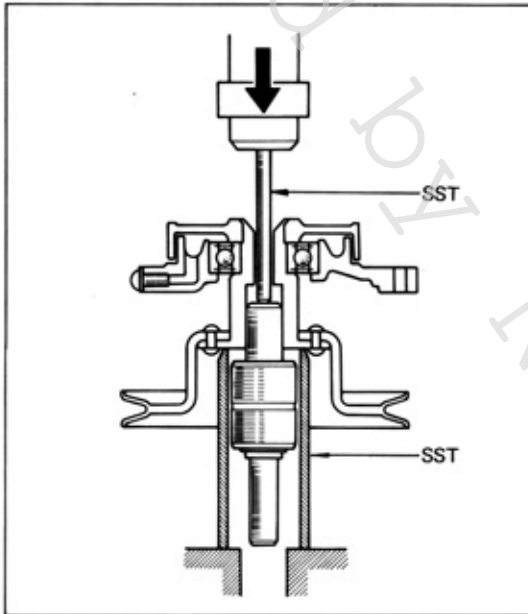
Heat the water pump cover to about 100°C (212°F).

Fig. 7-6



Using SST [09236-36010] and press, force out the bearing from cover.

Fig. 7-7



Using SST [09236-36010] and press, force out the bearing from fluid coupling.

ASSEMBLY

Assemble in numerical order.

Fig. 7-8

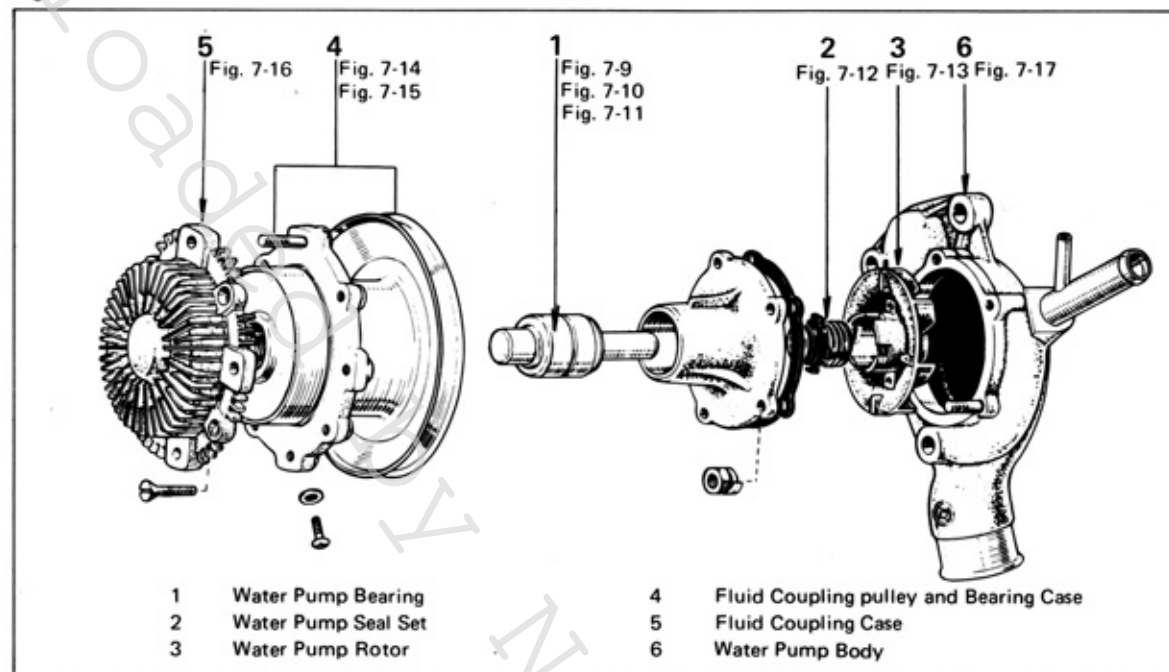
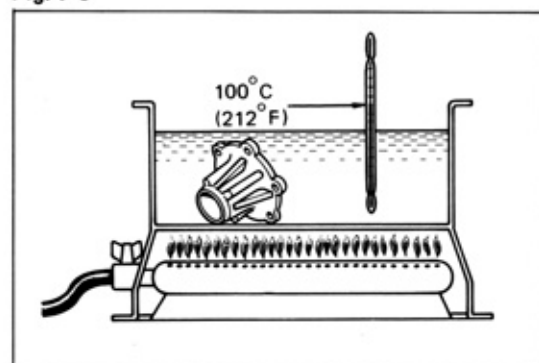
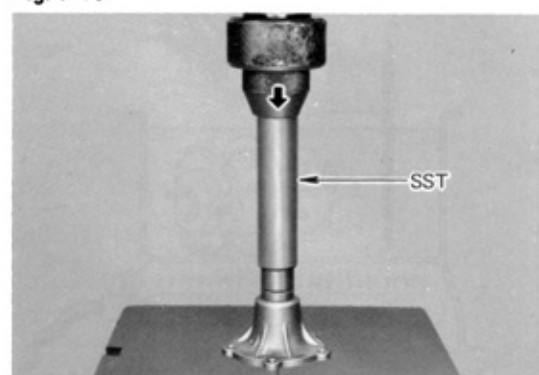


Fig. 7-9



Heat the cover to about 100°C (212°F).

Fig. 7-10

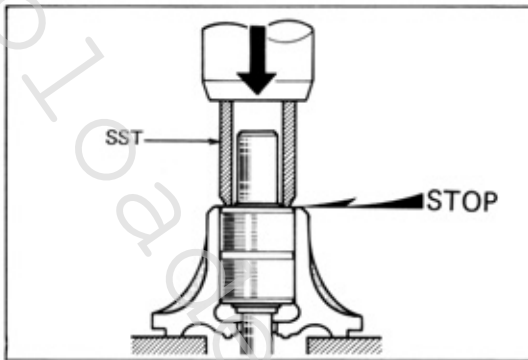


Using SST [09236-36010], press the bearing into the cover.

— caution —

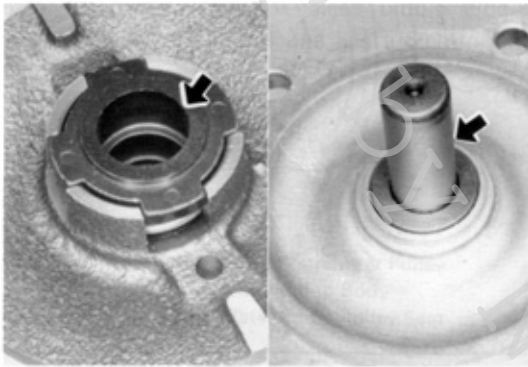
Never press on the bearing shaft.

Fig. 7-11



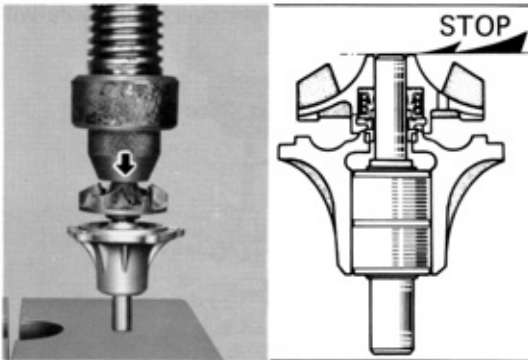
Press in until the bearing end surface is flush with the cover upper surface.

Fig. 7-12



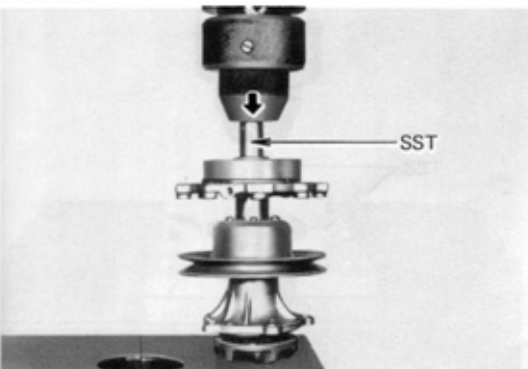
Apply a small amount of silicon oil on contacting surface between the floating seat and the thrust washer, and assemble the seal set.

Fig. 7-13



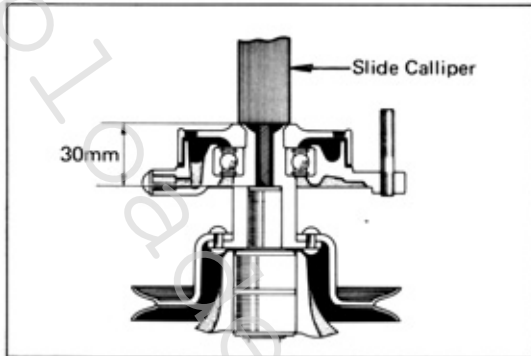
Press the rotor into the bearing shaft, and align the shaft and rotor at top end surface.

Fig. 7-14



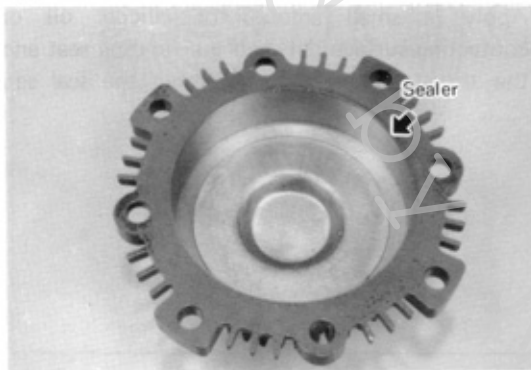
Using SST [09236-36010] and press, install the fluid coupling onto the bearing shaft.

Fig. 7-15



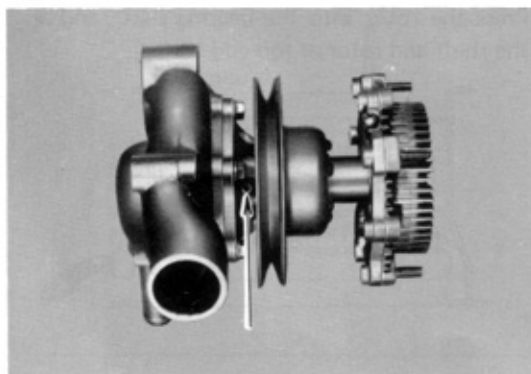
Install the fluid coupling as shown.

Fig. 7-16



Apply liquid sealer on the coupling case mounting surface and install the coupling case.

Fig. 7-17



Install so that the pump cover drain hole will be positioned downward.

Applicable Fluid
Silicon oil 6,000 cst. 25cc

WATER PUMP(WITH TEMPERED COOLING FAN) DISASSEMBLY

Disassemble in numerical order.

Fig. 7-18

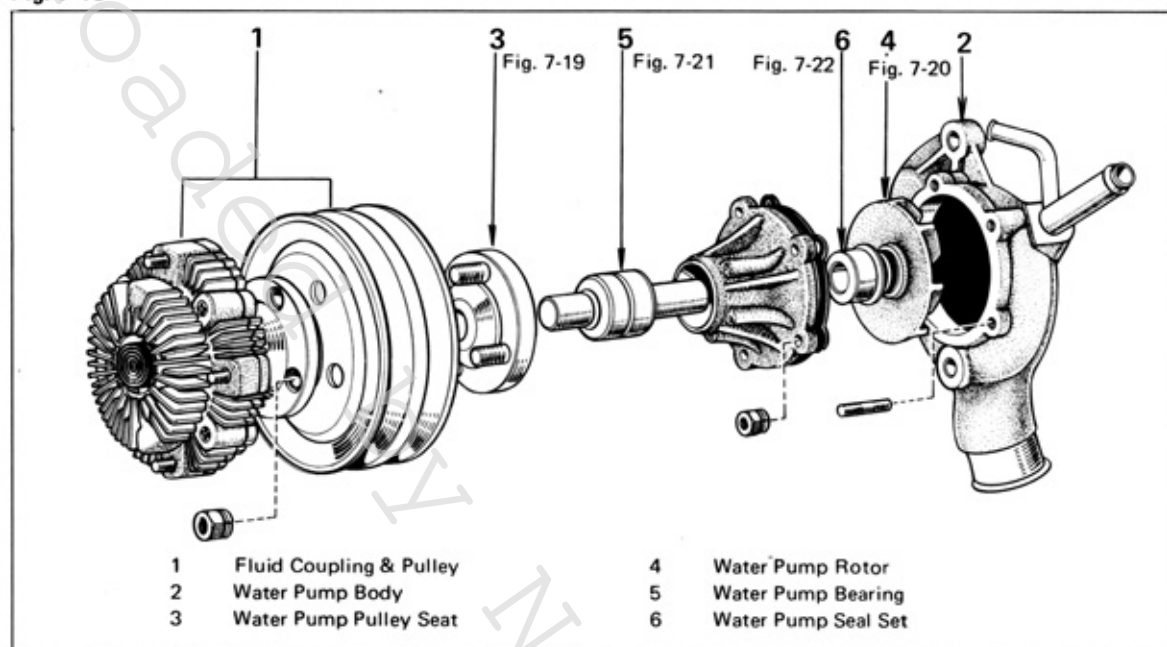


Fig. 7-19

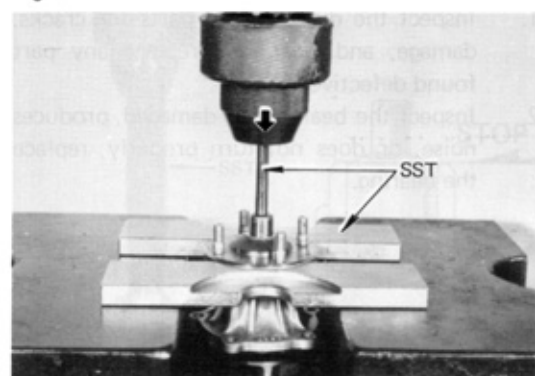
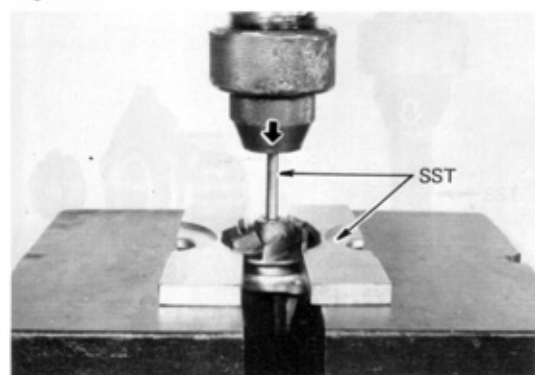


Fig. 7-20

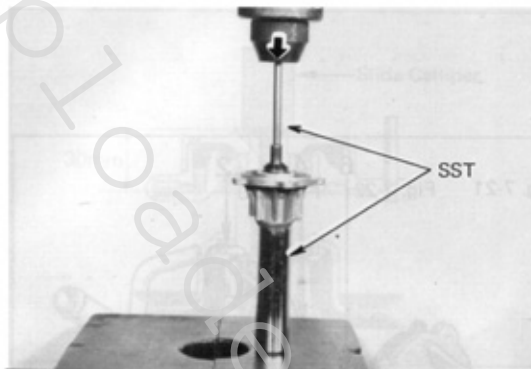


Using SST [09236-36010] and a press, force out the bearing shaft from the pulley seat.



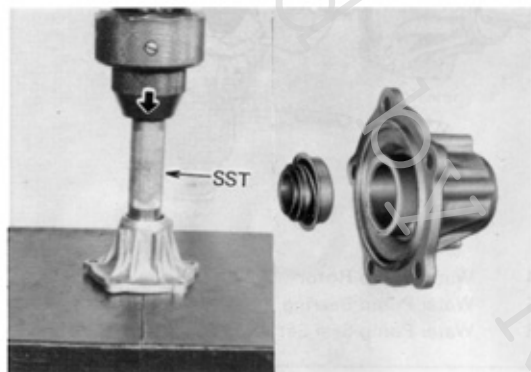
Using SST [09236-36010] and a press, force out the bearing shaft from the rotor.

Fig. 7-21



Heat the water pump cover to about 100°C (212°F), and using SST [09236-36010] and a press, force out the bearing from the pump cover.

Fig. 7-22

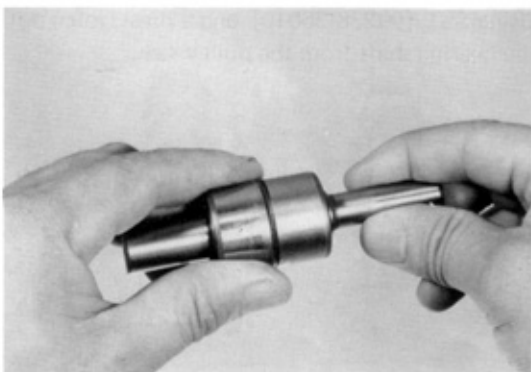


Using a press, force out the seal set from the pump cover.

— Note —

Force out from the pulley end.

Fig. 7-23



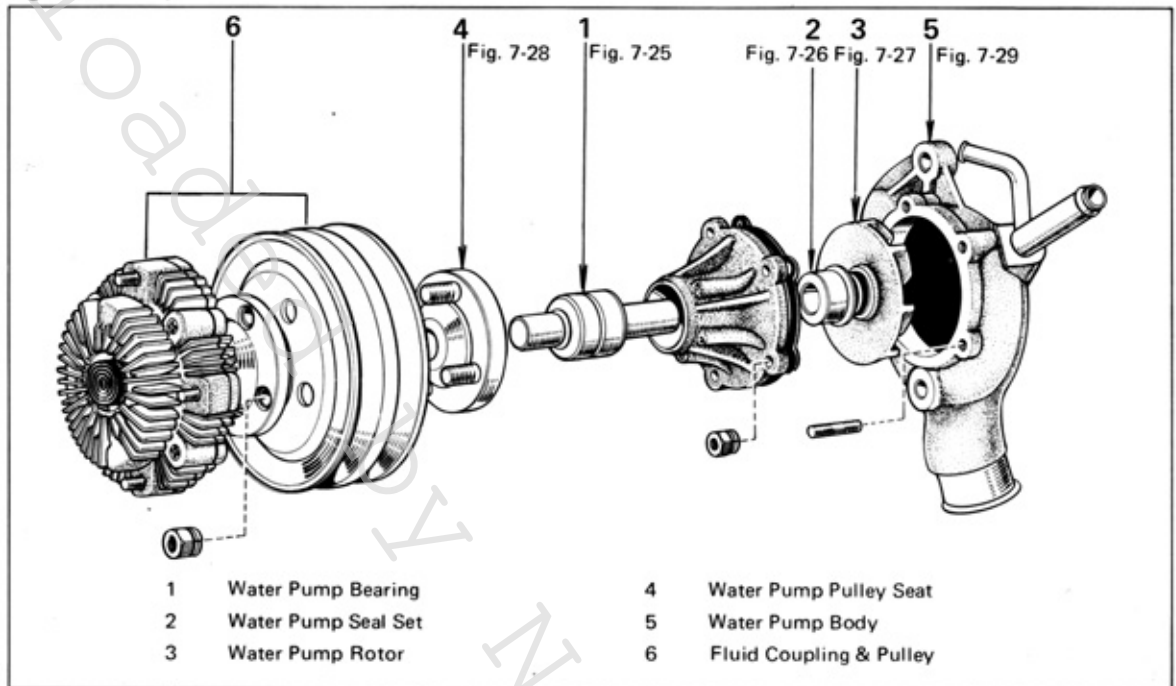
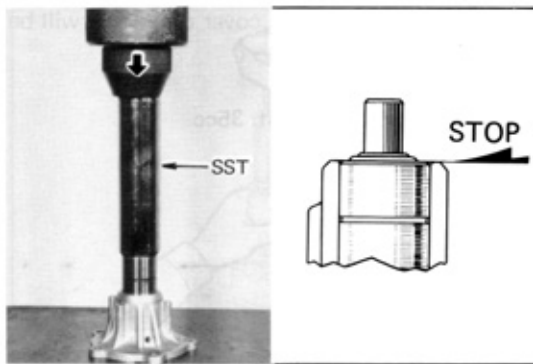
INSPECTION



1. Inspect the disassembled parts for cracks, damage, and wear, and replace any part found defective.
2. Inspect the bearing. If damaged, produces noise, or does not turn properly, replace the bearing.

ASSEMBLY

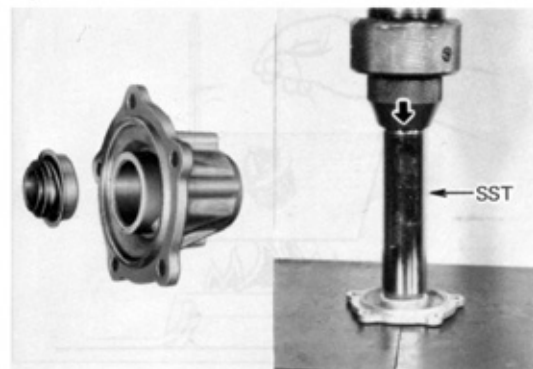
Assemble in numerical order.

Fig. 7-24**Fig. 7-25**

Heat the pump cover to about 100°C (212°F) and force in the bearing with SST [09236-36010] and press.

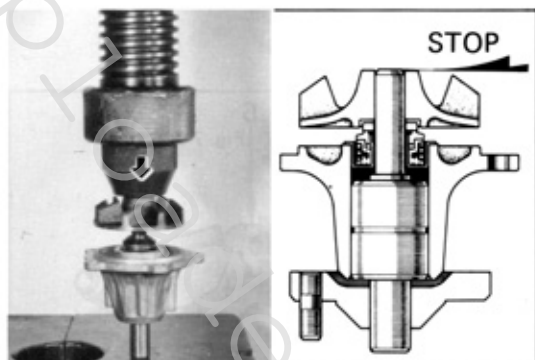
— Note —

Press in the bearing until its end surface is flush with cover surface.

Fig. 7-26

Apply liquid sealer on the seal set, and press the seal set into the pump cover.

Fig. 7-27

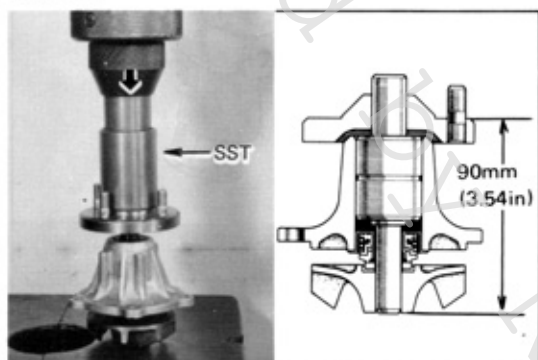


Using a press, force in rotor.

— Note —

Press in the rotor until it is flush with the shaft end.

Fig. 7-28

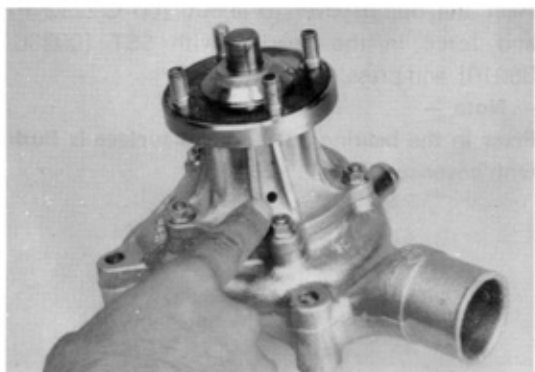


Using a press and SST [09238-40010], force in the pulley seat.

— Note —

Press in the pulley seat until the distance from the bearing shaft end surface to the pulley seat end surface is 90 mm (3.54 in) as shown.

Fig. 7-29



Install so that the pump cover drain hole will be positioned downward.

Applicable Fluid

Silicon oil 3,000 cst. 35cc

Fig. 7-30

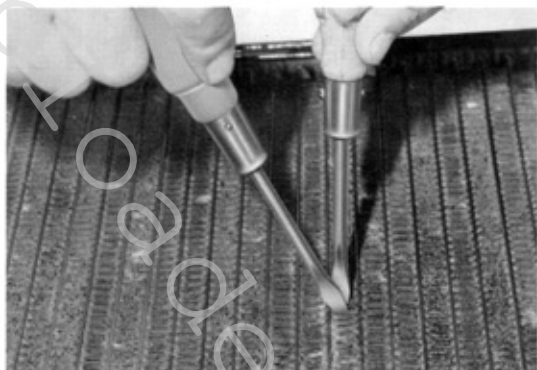


Fig. 7-31

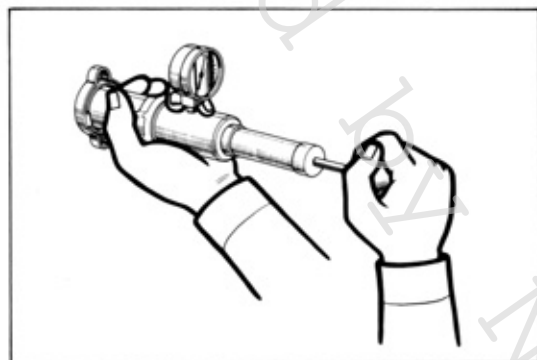


Fig. 7-32

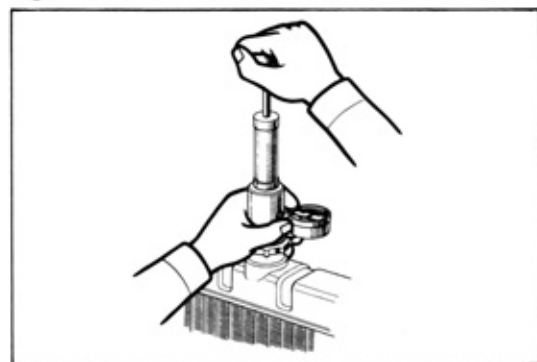
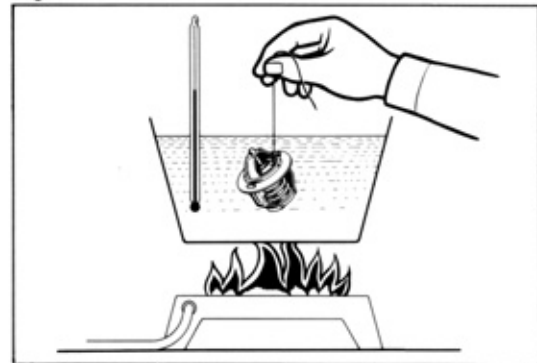


Fig. 7-33



RADIATOR

INSPECTION & REPAIR



1. Inspect the radiator core fins, and repair any fins blocking air passage by the method as shown.



2. Inspect the radiator cap regulation pressure and vacuum valves for spring tension and seating. If the pressure gauge drops rapidly and excessively, replace the radiator cap.

Valve opening pressure limit

0.6 kg/cm² (8.5 psi)

Standard 0.9 kg/cm² (12.8 psi)



3. Inspect the cooling system for leaks. Attach the pressure tester to the radiator and pump it to the specified pressure. If the pressure gauge drops, inspect all hoses and fittings for an external leak. If no external leak is found, an internal intake manifold, block or heater core leak should be suspected.

THERMOSTAT

INSPECTION



1. Replace if the valve remains open at normal temperature or does not have proper tightness when fully closed.
2. Immerse the thermostat in the water, and check the valve opening temperatures by heating the water gradually.
The valve is satisfactory if it starts to open at 80.5° to 83.5°C (177° to 182°F) and opens to more than 8 mm (0.32 in) at 95°C (203°F).
Replace if necessary.

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STARTING SYSTEM

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INSPECTION AND REPAIR	9 – 6
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STARTING SYSTEM CIRCUIT

Fig. 9-1

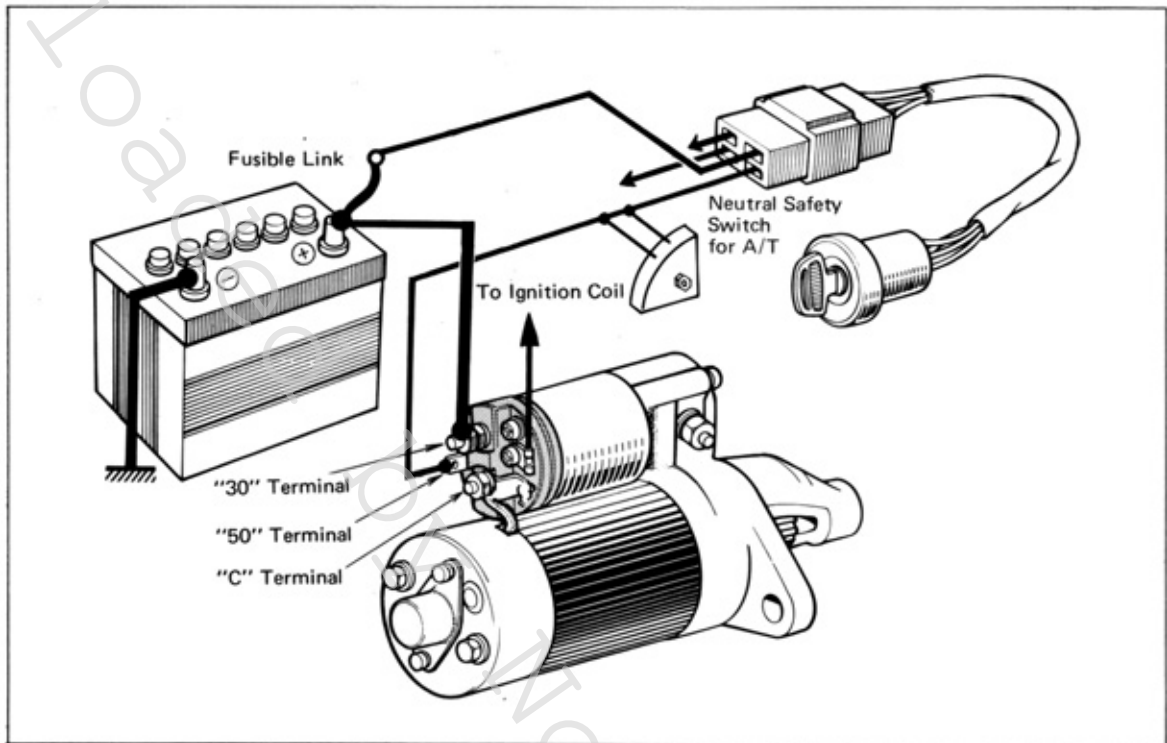
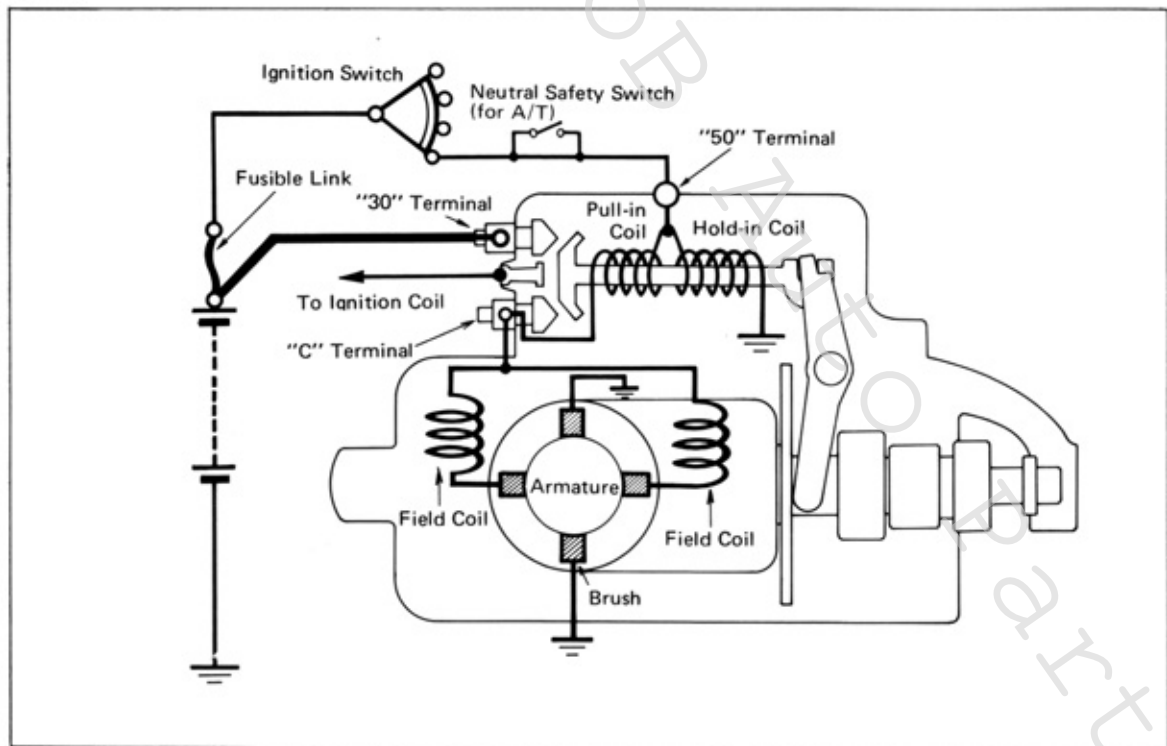


Fig. 9-2



STARTER

DISASSEMBLY

Disassemble in numerical order.

Fig. 9-3

- 1 Magnetic Switch
- 2 Bearing Cover
- 3 Lock Plate and Spring
- 4 Bolt
- 5 Commutator End Frame
- 6 Yoke with Brush Holder
- 7 Drive Lever Bolt
- 8 Armature and Drive Lever
- 9 Brush Holder
- 10 Snap Ring
- 11 Stop Collar
- 12 Clutch with Pinion Gear
- 13 Center Bearing (for 1.0KW)

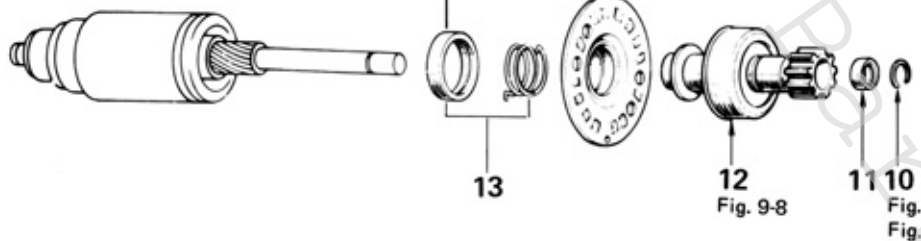
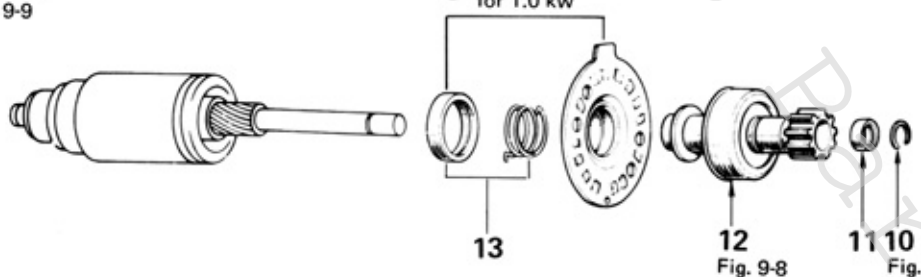
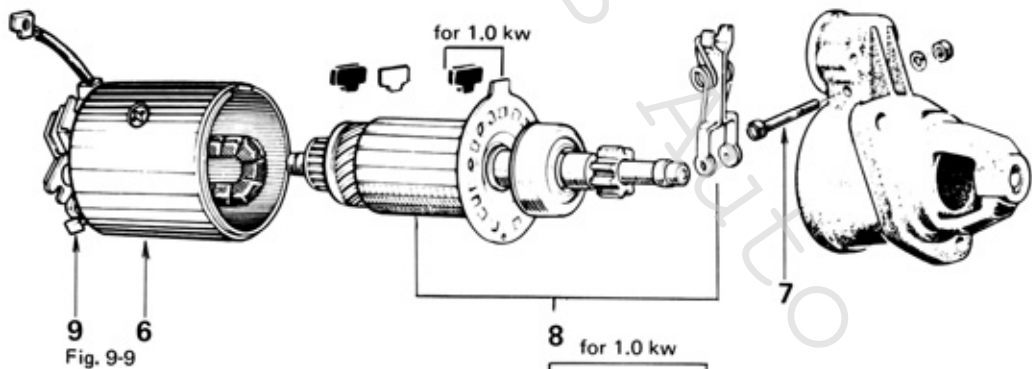
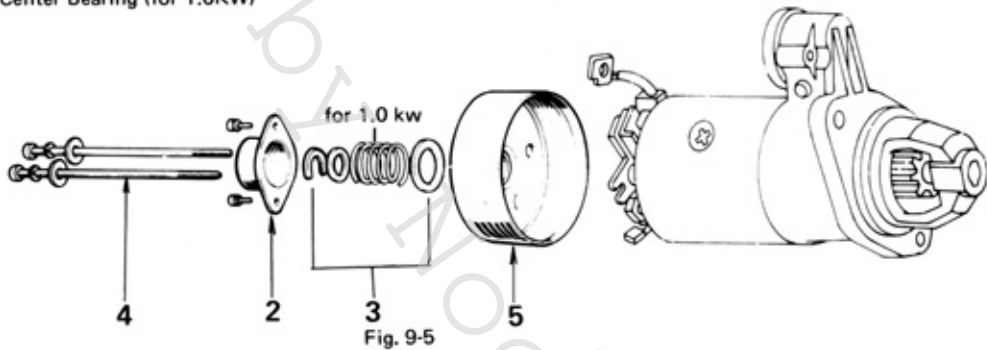
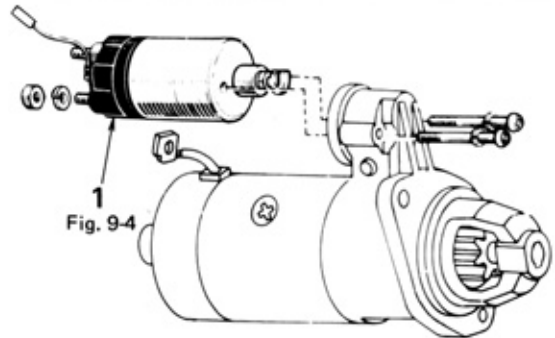


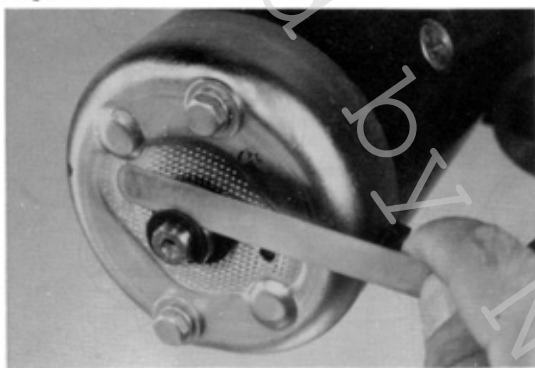
Fig. 9-9

Fig. 9-4



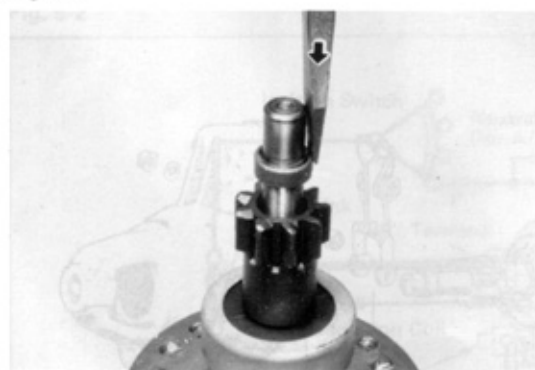
Disconnect lead wire before removing magnetic switch.

Fig. 9-5



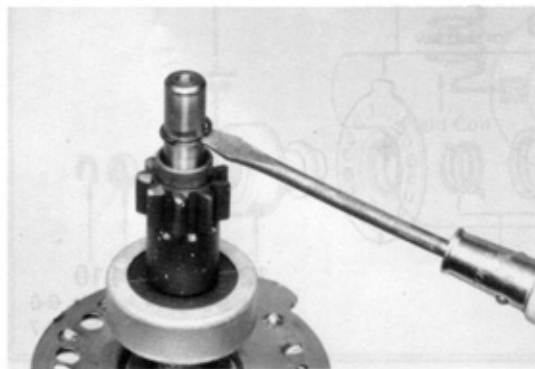
Check the armature shaft thrust clearance.
Thrust clearance limit 0.8 mm (0.032 in)

Fig. 9-6



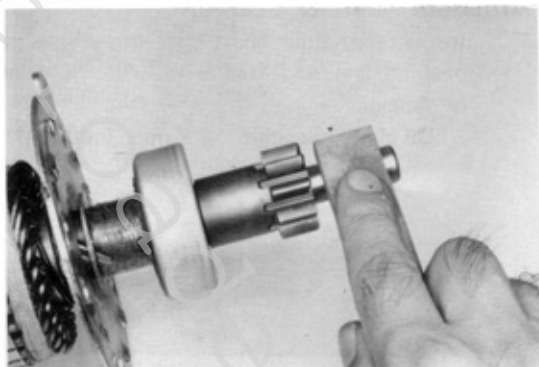
Tap in stop collar, using a screwdriver.

Fig. 9-7



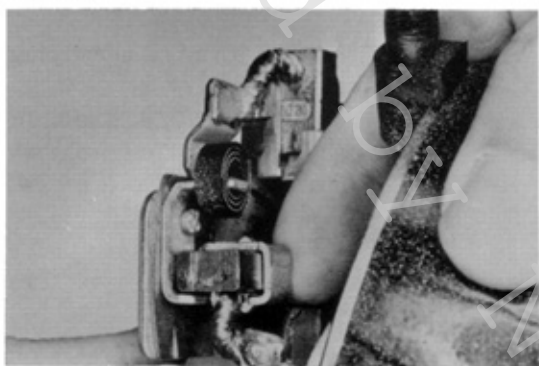
Pry the snap ring, using a screwdriver.

Fig. 9-8



If difficult to pull out the pinion, repair the shaft with an oil stone.

Fig. 9-9



Take off brushes and remove brush holder.

Fig. 9-11

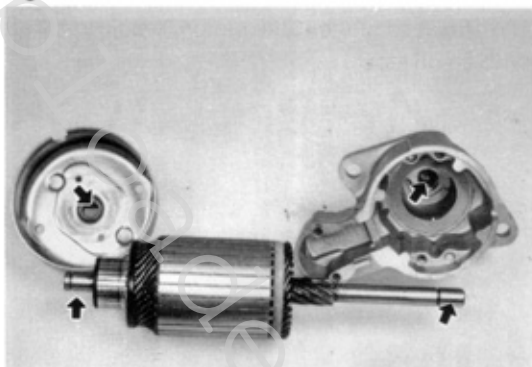


Fig. 9-12

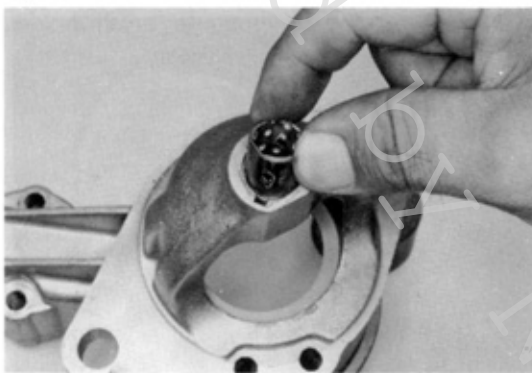


Fig. 9-13

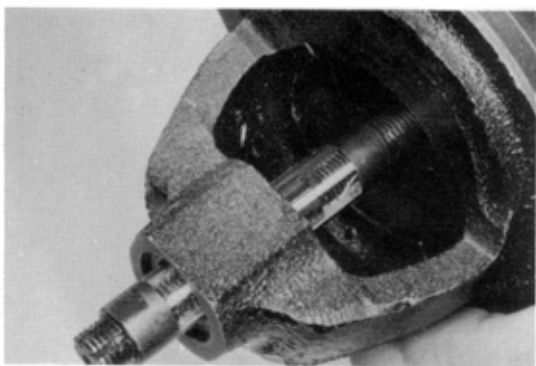
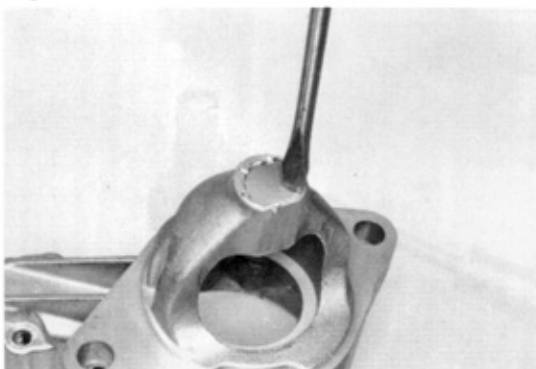


Fig. 9-14



INSPECTION AND REPAIR

Armature Shaft & Bearings



1. Inspect armature shaft end, drive housing bushing and end frame bushing for wear or damage.

Oil clearance limit 0.2 mm (0.008 in)



2. Bushing replacement.

- (1) Pry out the bushing cover and press out the bushing.
- (2) Aligning the bushing hole with the housing groove, Press in new bushing.

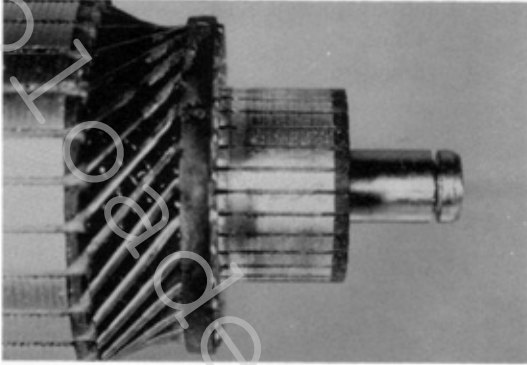
- (3) Ream bushing to obtain the specified clearance.

**Oil clearance 0.10 – 0.14 mm
(0.0039 – 0.0055 in)**



- (4) Clean the bore, and install new bushing cover.

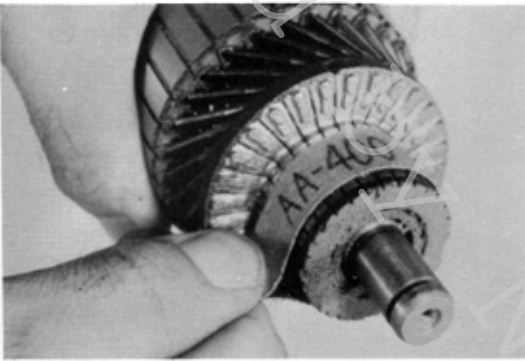
Fig. 9-15

**Commutator**

Inspect for the following items and repair or replace.

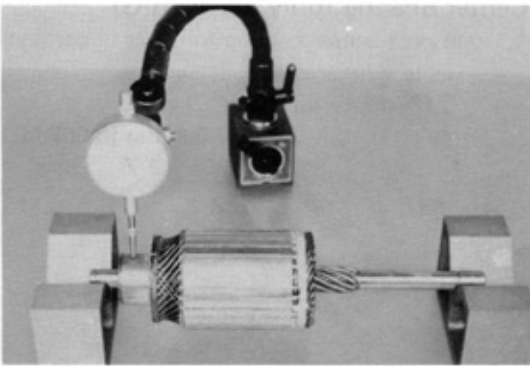
1. Dirty or burnt surface.
Correct by sandpaper or lathe if necessary.

Fig. 9-16



Use # 400 sandpaper.

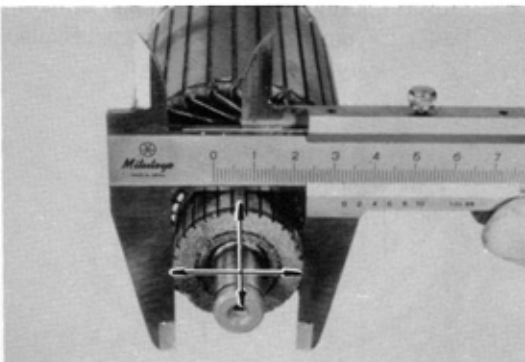
Fig. 9-17



2. Runout: Correct on a lathe if it exceeds the limit.

Runout limit	0.4 mm (0.016 in)
Standard	0.05 mm (0.0020 in)

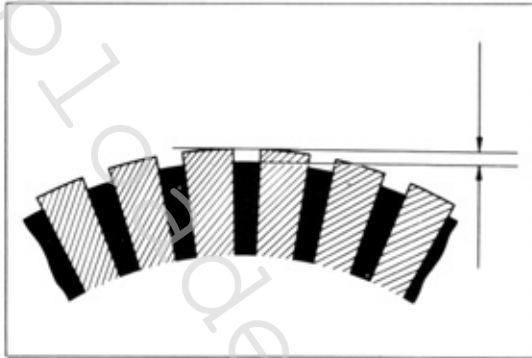
Fig. 9-18



3. Surface wear: If below the limit, replace armature.

Limit	31 mm (1.22 in)
Standard	32.7 mm (1.287 in)

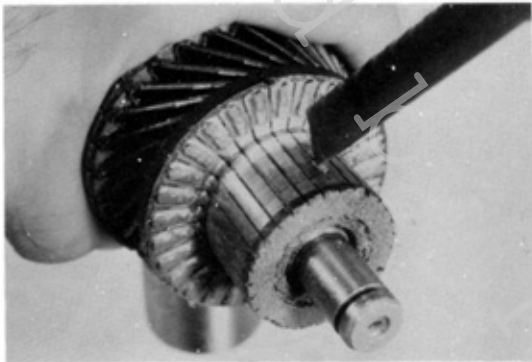
Fig. 9-19



4. Depth of segment mica.

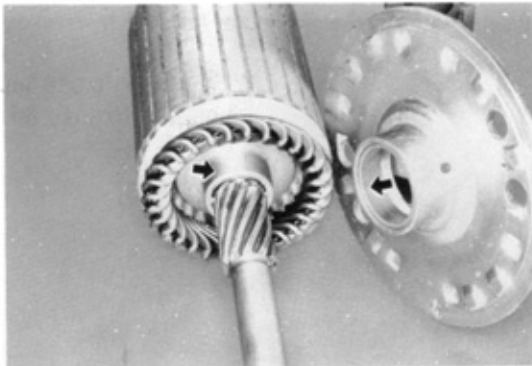
Limit	0.2 mm (0.008 in)
Standard	0.5-0.8 mm (0.020-0.031 in)

Fig. 9-20



Correct with a hacksaw blade.
After correcting, eliminate chips using
sandpaper.

Fig. 9-21

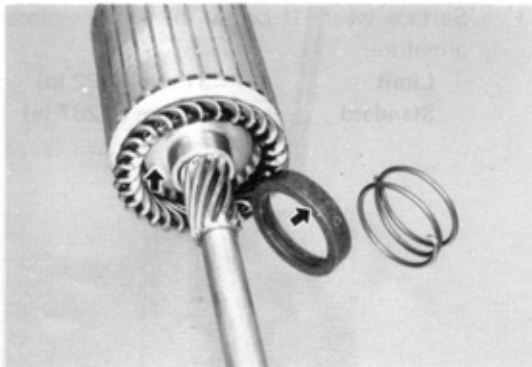


Center Bearing (only for 18R-G)

1. Inspect center bearing for wear or damage.
Replace if necessary.

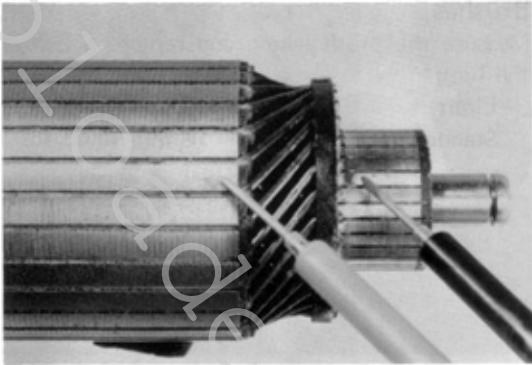
Clearance limit**0.2 mm (0.008 in)**

Fig. 9-22



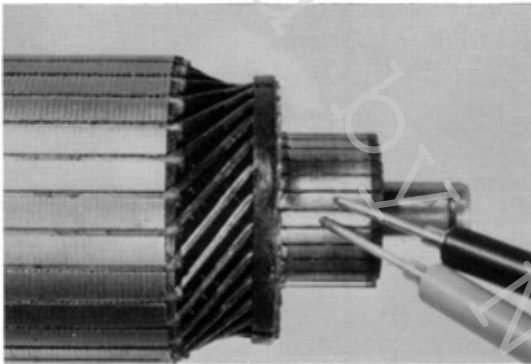
2. Inspect spring holder, spring and armature
shaft for cracks, wear or damage. Replace
if necessary.

Fig. 9-23

**Armature Coil**

1. Ground test
Check commutator and armature coil core. If there is continuity, the armature is grounded and must be replaced.

Fig. 9-24



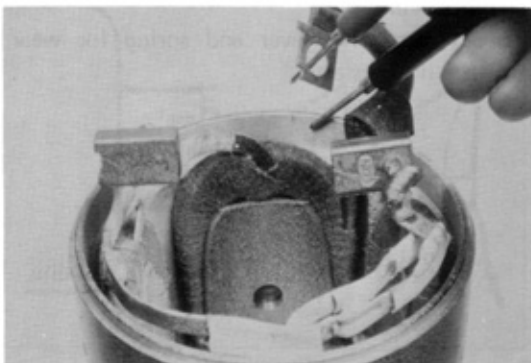
2. Open-circuit test
Check for continuity between the segments. If there is no continuity at any test point, there is an open-circuit and armature must be replaced.

Fig. 9-25

**Field Coil**

1. Open-circuit test
Check for continuity between the lead wire and field coil brush soldered connection. If there is no continuity, there is an open-circuit in the field coil, and it should be replaced.

Fig. 9-26



2. Ground test
Check for continuity between field coil end and field frame. If there is continuity, repair or replace the field coil.

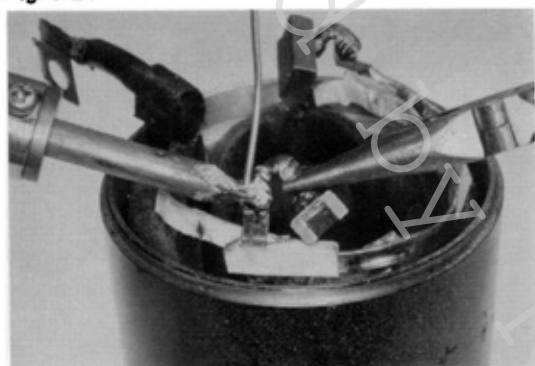
Fig. 9-27

**Brushes**

Measure the brush length and replace if below the limit.

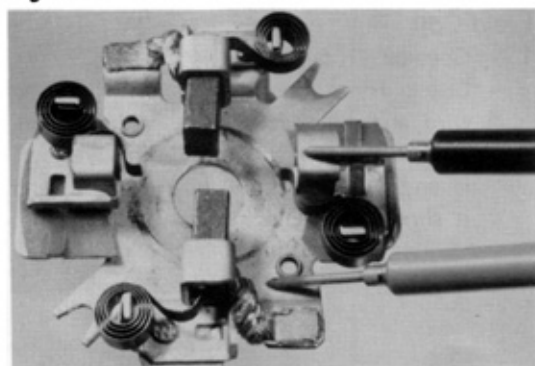
Limit	12 mm (0.47 in)
Standard	16 mm (0.63 in)

Fig. 9-28

**Brush Replacement**

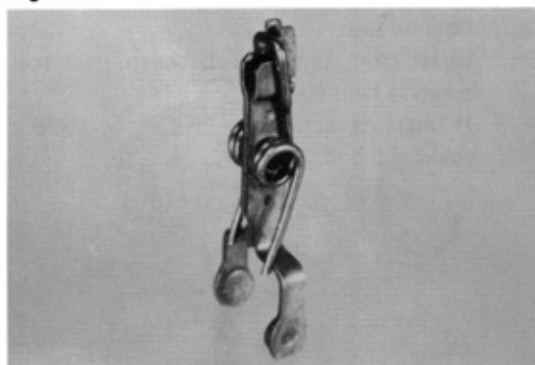
Solder brush lead firmly.

Fig. 9-29

**Brush Holder**

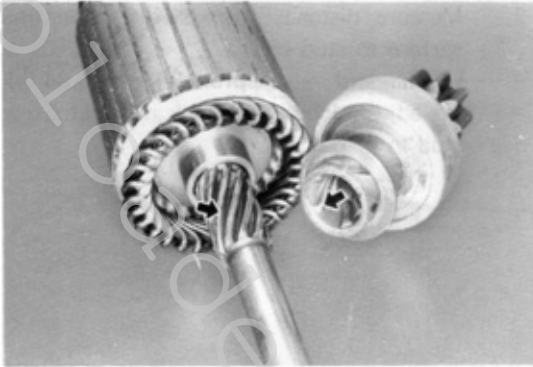
Check insulation between the (–) brush holder and (+) brush holder. Repair or replace if continuity is indicated.

Fig. 9-30

**Drive Lever**

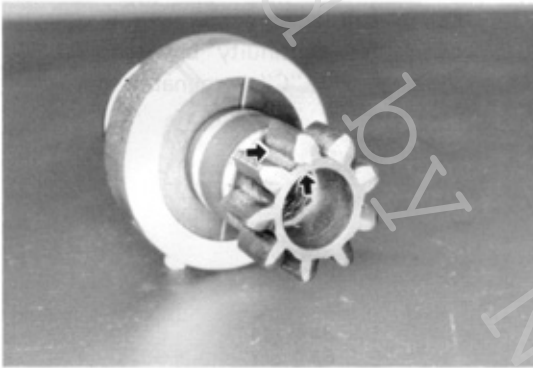
Inspect the drive lever and spring for wear. Replace if necessary.

Fig. 9-31

**Starter Clutch and Pinion Gear**

1. Inspect spline teeth for wear and damage. Replace if necessary.
2. Inspect pinion for smooth movement.

Fig. 9-32



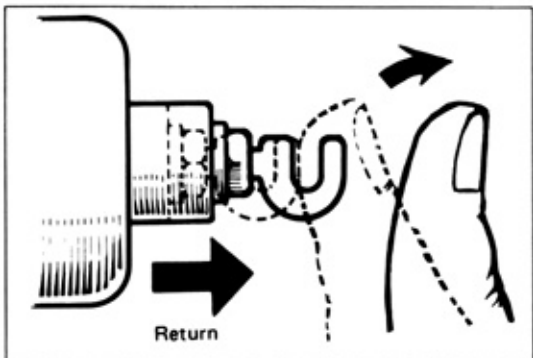
3. Inspect pinion gear teeth and chamfer if worn or damaged.

Fig. 9-33



4. Rotate pinion. It should turn free in clockwise direction and lock when turned counterclockwise.

Fig. 9-34

**Magnetic Switch**

1. Push in plunger and release it. The plunger should return quickly to its original position.

Fig. 9-35

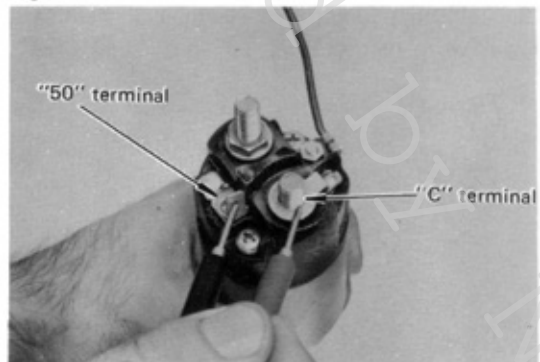


2. Measure distance from switch mounting surface to stud end.

Standard approx. 34 mm (1.34 in)

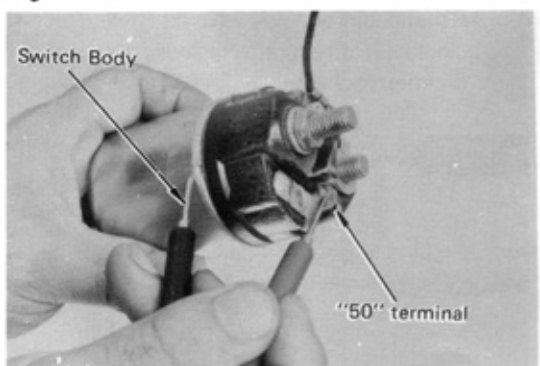
To adjust, loosen the lock nut and screw stud in or out.

Fig. 9-36



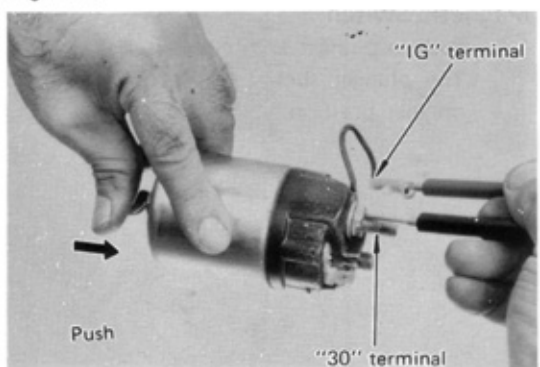
3. Pull-in coil open circuit test. Check for continuity between the "50" terminal and "C" terminal.

Fig. 9-37



4. Hold-in coil open circuit test. Check for continuity between the "50" terminal and switch body.

Fig. 9-38



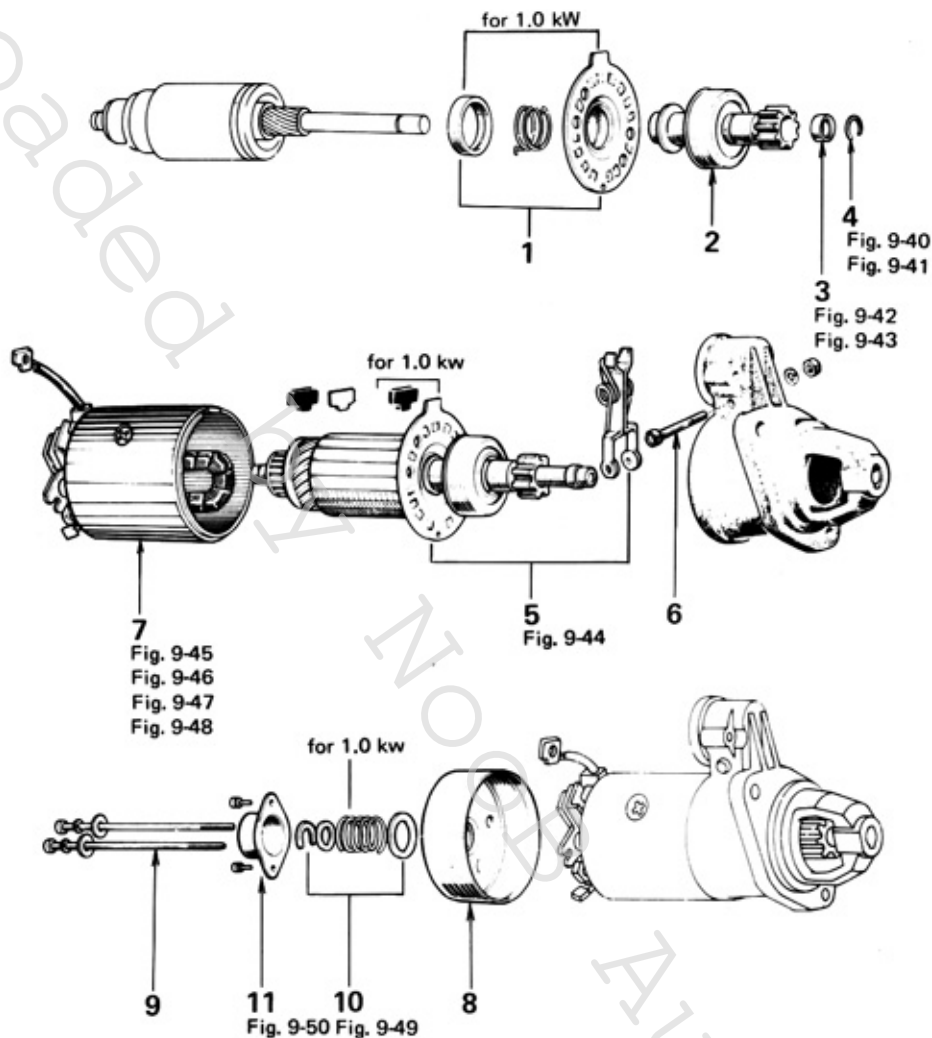
5. I.G. terminal continuity test. Push in plunger until it stops. Check for continuity between "30" terminal and lead wire.

— Note —

Perform the switch operation test after assembling it to the motor.

ASSEMBLY

Assemble in numerical order.

Fig. 9-39

- 1 Center Bearing (for 1.0 kW)
- 2 Clutch with Pinion Gear
- 3 Stop Collar
- 4 Snap Ring
- 5 Armature and Drive Lever
- 6 Drive Lever Bolt
- 7 Yoke with Brush Holder
- 8 Commutator End Frame
- 9 Bolt
- 10 Lock Plate and Spring
- 11 Bearing Cover
- 12 Magnetic Switch

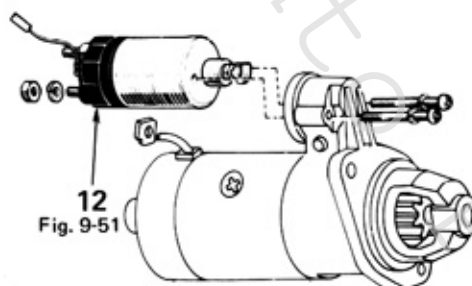
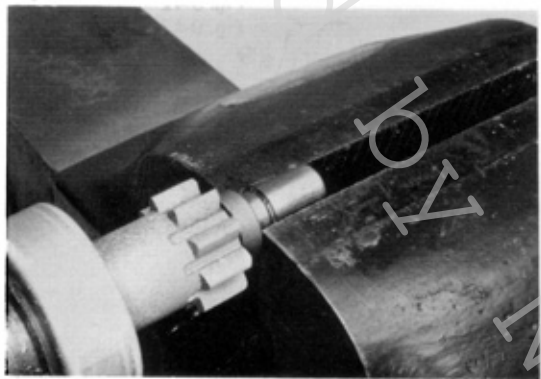


Fig. 9-40



Fit snap ring into shaft groove.

Fig. 9-41



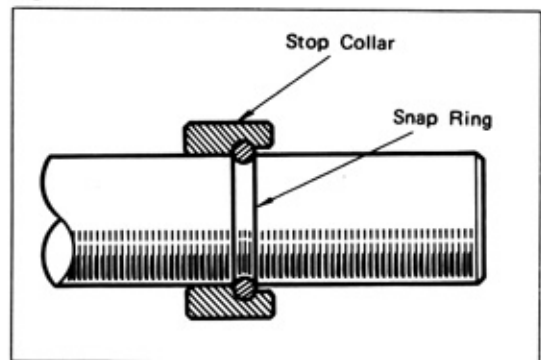
Compress the snap ring with a vise.

Fig. 9-42



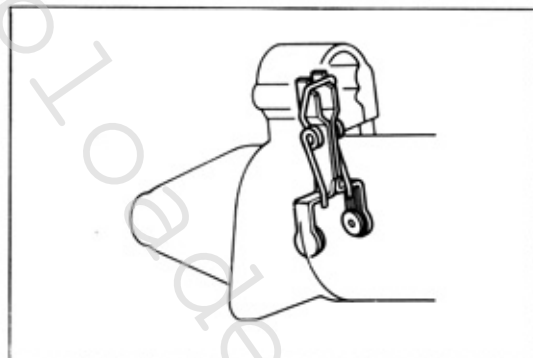
Tap pinion to slide the stop collar onto snap ring.

Fig. 9-43



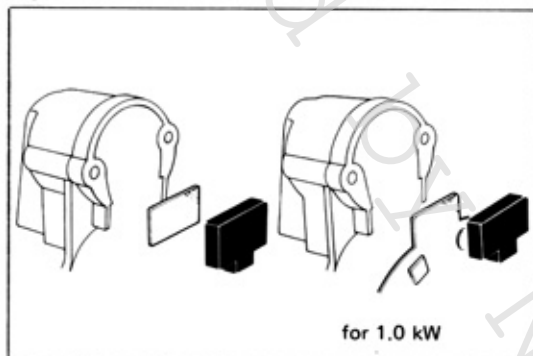
Make sure that the snap ring fits correctly.

Fig. 9-44



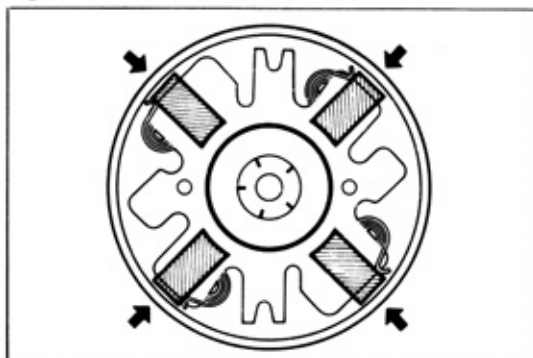
Assemble drive lever in direction as shown.

Fig. 9-45



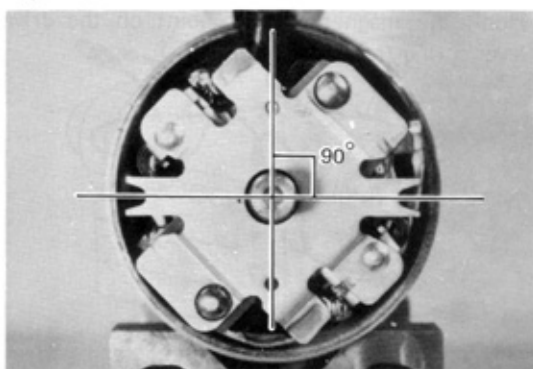
Match notch in yoke with tab on rubber plate and assemble yoke with drive housing.

Fig. 9-46



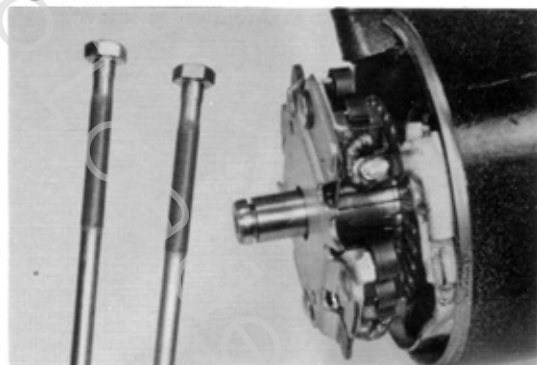
Assemble brushes, being careful not to damage them.

Fig. 9-47



After installation, position the holder as shown.

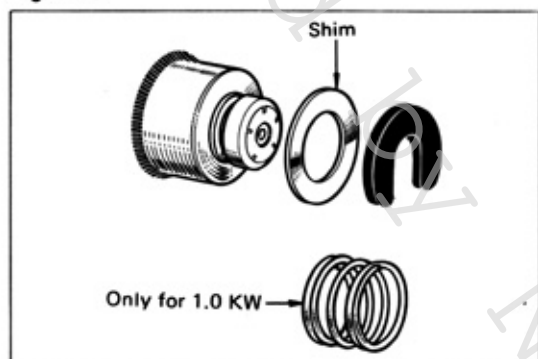
Fig. 9-48



Check that the (+) wires are not grounded.

- Field coil
- Brush (+) leads
- Through bolts

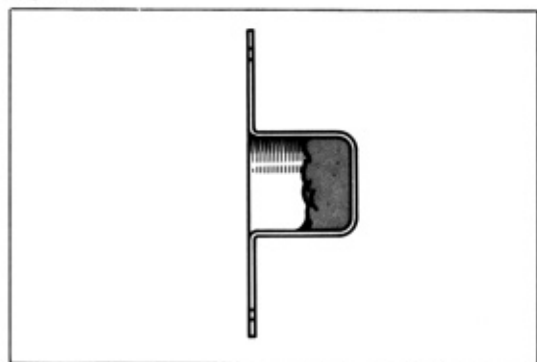
Fig. 9-49



Install the lock plate and measure the armature shaft thrust clearance. If clearance exceeds the specified value, correct by increasing the number of shims.

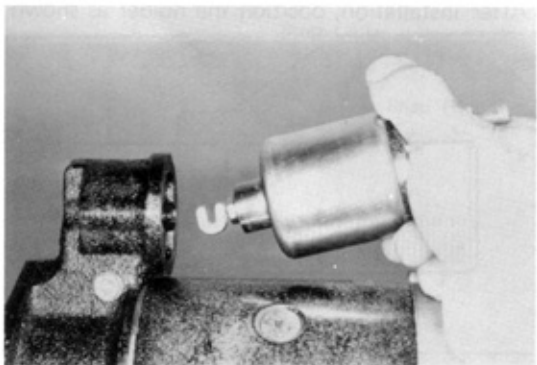
Thrust clearance	0.05-0.35 mm (0.002-0.0138 in)
Adjusting shim thickness	0.5 mm (0.02 in)

Fig. 9-50



Install end frame cap not more than half full of grease.

Fig. 9-51



Hook the magnetic switch joint on the drive lever spring from the lower side.

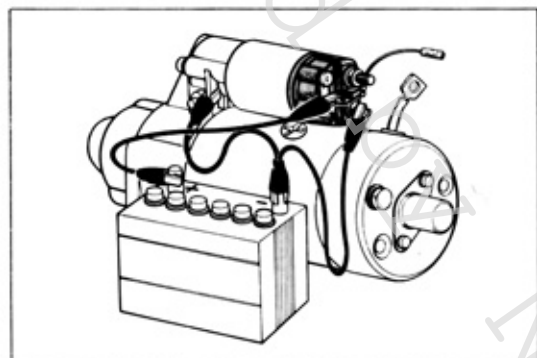
– Precaution –

These tests must be performed in short time (3-5 seconds) to prevent the coil from burning. Disconnect the field coil lead from "C" terminal.

PERFORMANCE TEST

Check the magnetic switch performance and pinion gap as follows:

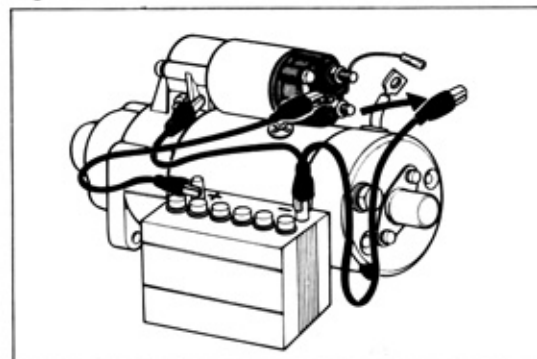
Fig. 9-52



1. Pull-in test

Connect magnetic switch to battery as shown. (negative side to "C" terminal and switch body; positive side to "50" terminal). If the pinion has definitely jumped out, the pull-in coil is satisfactory.

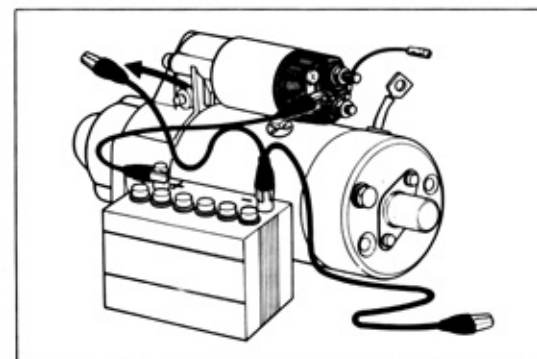
Fig. 9-53



2. Hold-in test

Next disconnect the "C" terminal. The pinion should remain in jumped-out condition.

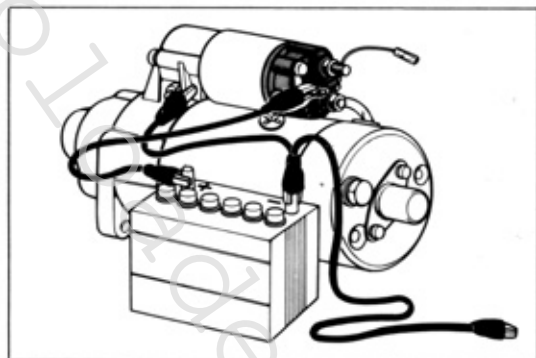
Fig. 9-54



3.

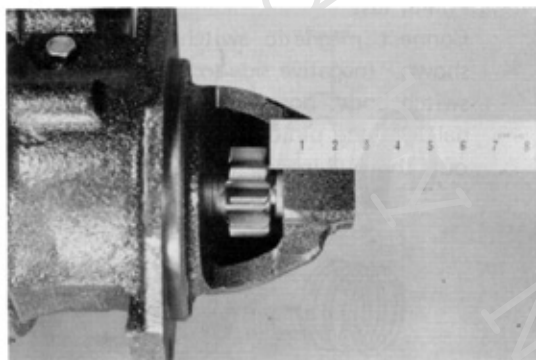
Check the plunger return. When disconnecting the switch body, the pinion should return quickly.

Fig. 9-55



4. Check the pinion clearance.
- (1) Connect the magnetic switch to battery as shown.
Field coil lead to "C" terminal
Battery negative side to body
Battery positive side to 50 terminal

Fig. 9-56



- (2) Move the pinion to armature side to eliminate the slack, and check the clearance between the pinion end and stop collar.

Standard clearance

**1.0-4.0 mm
(0.04-0.16 in)**

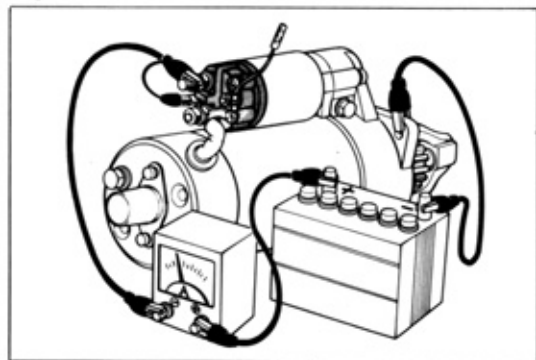
Fig. 9-57



- (3) Adjust if necessary after loosening lock nut.

<u>Clearance</u>	<u>Stud</u>
Too large	→ Screw in
Too small	→ Screw out

Fig. 9-58



5. No-load performance test
- Connect the field coil lead to the "C" terminal, making sure that the lead wire is not grounded.
- Connect starter to battery. If the starter shows smooth and steady rotation with the pinion jumping out and draws less than specified current, it is satisfactory.

Specified current

Less than 50 A